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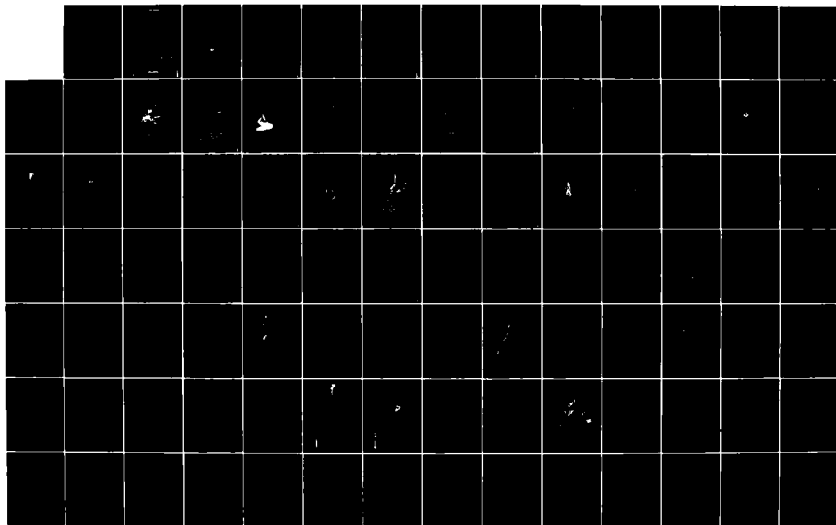
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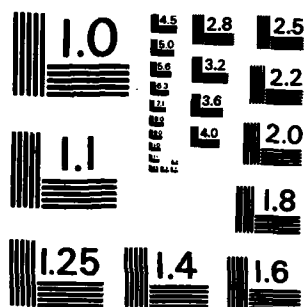
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**RANRL TECHNICAL MEMORANDUM
(EXTERNAL) No. 5/82**

**COMPARISONS BETWEEN PATTERNS OF
SEA-SURFACE TEMPERATURE AND
SUB-SURFACE PARAMETERS IN
THE WESTERN TASMAN SEA (U)**

BY
**P. J. MULHEARN
&
L.J. HAMILTON**

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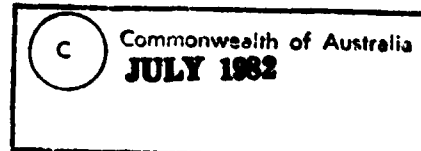
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RANRL TECHNICAL MEMORANDUM (EXTERNAL) NO. 5/82

COMPARISONS BETWEEN PATTERNS OF SEA-SURFACE TEMPERATURE
AND SUB-SURFACE PARAMETERS IN THE WESTERN TASMAN SEA (U)

P.J. MULHEARN

and

L.J. HAMILTON



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ABSTRACT

→ Comparisons are presented between patterns of sea-surface temperature, temperature at 250m, mixed-layer depth and dynamic height for the western Tasman Sea. Data are from ship cruises and aerial surveys. It is shown by comparing deep current structures, shown by the temperature fields at 250 metres and/or dynamic heights, with surface temperature patterns that on many occasions the latter revealed the East Australian Current flowing down the coastline, turning eastwards between 30° and 32°S and, sometimes, turning back to the north. Also on most occasions in winter and spring, and sometimes in summer-autumn, warm-core eddies were apparent in surface temperature patterns. In general, surface mixed-layers are deeper above anticyclonic features and shallower above cyclonic features. ←

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1. INTRODUCTION

In real-time ocean-analysis, data on sea-surface temperatures (SST) are far more readily available than values of sub-surface parameters such as the temperature field at 250 metres or dynamic heights from which ocean and current structure can be determined by visual examination of iso-contours. It is therefore worthwhile considering the extent to which SST's can reveal the positions of major fronts and eddies, and variations in surface mixed-layer depth (MLD). In the western Tasman the major mesoscale features are revealed by the distribution of the temperature isotherms at 250m (T250) as well as by Dynamic Height variations.

In this note thirty four case-studies are presented to show comparisons between SST and either T250 or dynamic height to determine if features shown in the T250 and/or dynamic height patterns are also seen in the SST pattern. Eighteen of these cases also show how the MLD pattern varies with that for T250 (or dynamic height), and for nine cases the close correspondence between T250 and dynamic height is demonstrated.

The thirty four cases presented also demonstrate the types of mesoscale variability to be expected in the western Tasman. For a few cases temperature sections through areas of interest are included to give an indication of vertical structure.

2. THE DATA

Data were obtained from the papers of Hamon (1965), Boland and Hamon (1970), Nilsson and others (1977), Nilsson and Cresswell (1981), Andrews and others (1980), Lawrence (1980), Boland and Church (1981), the bathythermograph data banks of C.S.I.R.O., Cronulla, and of the Australian Oceanographic Data Centre (AODC). For dynamic height values limited use was made of C.S.I.R.O.'s Nansen cast data bank.

The data is presented as sets of diagrams of sea-surface temperature, mixed-layer depth, temperature at 250 metres, and dynamic height for each survey, or sea-surface temperature and temperature at 250 metres. See Figs 1-99 and List of Figures.

3. MAIN FEATURES OF WESTERN TASMAN SEA OCEANOGRAPHY

Typically the East Australian Current (EAC) flows down the eastern Australian coast, separates from it between Smoky Cape and Sugarloaf Point (i.e. between 31° and 32° S) and turns eastwards. It then either turns back towards the north forming a large meander, or simply continues eastwards to the vicinity of Lord Howe Is.

When a meander forms it sometimes pinches off to form a detached warm-core eddy between approximately 34° S and 38° S. More than one eddy may be present at one time.

4. COMPARISONS BETWEEN SST AND T250 (OR DYNAMIC HEIGHT) PATTERNS

Infra-red (i.r) images of the sea-surface from satellites often reveal filaments of warm surface water being advected southward along the East Australian Current, and around both cyclonic and anti-cyclonic features which, in the southern hemisphere, have clockwise and anticlockwise circulation respectively. It is clear that very detailed ship surveys of sea-surface temperature would be required to delineate these thin features and cruises of this nature have not been undertaken. Ship-surveys can also take one to two weeks to cover an area so that the data obtained are not synoptic. Patterns of oceanographic variables may shift significantly in this time period. For these reasons it is suspected that satellite i.r. images will reveal deeper oceanographic features more clearly than the SST data from ship cruises which are discussed herein.

Principal features observed in SST patterns which relate to deeper current structure are:

- (i) a front with warmer water to the east, at the western edge of the East Australian Current as it flows down the coast to about 30° to $32\frac{1}{2}^{\circ}$ S. A tongue of warm surface water, parallel to the current may also be present, which at times is fairly broad. (See Figs. 1, 9, 15)
- (ii) A surface front defining the EAC as it swings eastwards with colder water to the south. Occasionally a warm tongue parallel to the current is also present. (See Figs. 7, 9, 17, 19, 24, 28 for example)

- (iii) A surface front, with warmer water to the west, on those occasions when the EAC swings back towards the north.
(See Figs. 9, 17, 46)
- (iv) Surface fronts around warm-core eddies. These are sometimes not apparent on the northern side of eddies. Warm surface tongues may also be present around the eddy edge. (See Figs. 7, 42, 62)

Table I shows the occasions on which these features were observed on SST patterns on individual cruises compared with the occasions they were seen to be present from deep current structure in T250 and/or dynamic height patterns. On the 22 surveys covering the EAC flowing southward along the coast the current was evident on 13 (59%) occasions. The surface front may be missed on ship-surveys if it occurs too close inshore. On the 23 surveys covering the eastward turning of the EAC it showed up in SST patterns on 19 (83%) occasions, while SST patterns revealed the EAC returning to the north on 7 (70%) of the 10 occasions on which this feature was found. No seasonal dependence was discernable in the correspondence between SST patterns and the above features of the EAC.

In contrast clear seasonal dependence was found in the extent to which SST patterns showed up warm-core eddy positions. Of 22 surveys covering eddies, SST patterns revealed them on 13 (59%) of occasions.....
..... Table II summarises the percentage of cruises in which various features were visible in SST patterns and Table III shows the seasonal dependence of the correspondence between SST patterns and deeper structure in eddies. Note that from June to Nov. SST's showed up the eddies on 75% of occasions. Seasonal variations in temperature in warm-core eddies are discussed in Mulhearn (1982).

5. COMPARISONS BETWEEN MLD AND T250 (OR DYNAMIC HEIGHT) PATTERNS

Mixed-layer depth patterns are shown in Figs. 2, 12, 20, 27, 29, 31, 33, 36, 40, 43, 47, 59, 83, 90, 96. MLD is defined as depth at which temperature deviates from its surface value by 0.2°C . Some of the patterns are quite complex and details of the variations do not always bear a clear relation to the deeper structure. This could be due either to internal wave activity or variations in mixed-layer deepening caused by

atmospheric effects. Some conclusions can however be drawn. The surface mixed-layer is in general deeper over anticyclonic features, such as warm-core eddies and southward bulges in the EAC, and shallower over cyclonic (colder) features. MLD increases as the centre of an anticyclonic feature is approached. Shallowing of mixed-layers at fronts relative to values outside an anticyclonic feature is often not apparent, though some complex variations must occur in the frontal region itself when there are considerable horizontal temperature variations. Variations of MLD in warm-core eddies are discussed in Mulhearn (1982).

6. COMPARISONS BETWEEN T250 AND DYNAMIC HEIGHT PATTERNS

As has been discussed in Nilsson and Cresswell (1981) there is a strong correlation between T250 and the Dynamic Height of the sea-surface relative to 1300m. Both Dynamic Height and T250 patterns are shown for cruises in the following months of 1978 - March, May-June, June, August, September, late September and December, and for cruises in February 1979 and April 1980. The correspondence is probably closer than observed in some cases because of the limited number of nansen-casts available. Note: Some of the dynamic height patterns were drawn from dynamic heights calculated using T250 values in a regression relationship, and Nansen station data, so not all T250 and dynamic height patterns given are independent. Dynamic height patterns formed from T250's are shown in Figs. 13, 16, 57, 66 and 69.

ACKNOWLEDGEMENTS

Thanks are due to Mr. R. Edwards of C.S.I.R.O. and Mr. B. Searle of AODC for their assistance in providing data from their respective data banks and to Lt. Cdr. John Bracher, RAN and C.P.O. C. Fullwood, R.A.N., for helping in plotting up some of the data.

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LIST OF FIGURES

CRUISE	SST	MLD	T ₂₅₀	DYN. HT.	CROSS SECTION	DATE	
G3/60	1	2		3	4	Nov 8 - Dec 4	1960
G5/62	5			6		Sep 30 - Oct 10	1962
G4/63	7			8		Sep 9 - 18	1963
G5/63	9			10		Nov 7 - 15	1963
G1/64	11	12		13	14	Jan 13 - Feb 6	1964
G3/64	15			16		Mar 18-25	1964
G4/64	17			18		Aug 3 - 13	1964
G6/64	19	20		21	22,23	Sep 16 - 27	1964
G9/65	24			25		Nov 15 - 28	1965
K3/77/1	26	27	27a			Feb 28 - Mar 7	1977
K3/77/2	28	29	29a			Mar 13 - 17	1977
RANRL6/77	30	31	31a			Mar 22 - 28	1977
SP3/78	32	33	34			Feb 3 - 12	1978
SP4/78	35	36	37	38		Mar 8 - 22	1978
SP5&6/78	39	40		41		Mar 30 - Apr 11	1978
SP8/78	42	43	44	45		May 22 - June 6	1978
SP9/78	46	47	48	49		June 8 - 19	1978
SF10/78	50			51		July 20 - Aug 4	1978
SP11/78	52		53	54		Aug 5 - 18	1978
DM	55		56	57		Sep 1 - 11	1978
SP12/78	58	59	60	61		Sep 15 - 22	1978
SP17/78	62		63			Dec 9 - 11	1978
AXBT	64		65	66		Dec 13	1978
KIMBLA	67		68	69		Feb 11 - 19	1979
SP3/79	70		71			Mar 18 - 28	1979
SP6/79 Part 1	72		73			May 10 - 22	1979
SP6/79 Part 2	74		75			May 10 - 22	1979
SP7/79 First Survey	76		77			May 23 - June 6	1979

SP7/79	Second Survey	78	79	May 23 - June 6	1979
SP8/79		80	81	July 5 - 18	1979
SP9/79		82	83 84	Aug 17 - 31	1979
SP10/79		85	86	Sep 20 - Oct 3	1979
SP11/79		87	88	Oct 17 - 30	1979
SP3/80		89	90 91	Feb 5 - 12	1980
SP6/80		92	93 94	Apr 11 - 30	1980
YARRA]		95	96 97	July 25 - 31	1980
SP3/80]				Sep 25 - Oct 18	1981
SO4/81		98	99		

SYMBOLS USED:

AXBT - Aerial Survey

DM - HMAS Diamantina

G - HMAS Gascoyne

K - HMAS Kimbla

SP - Sprightly (CSIRO) SO - FRV Soela

SST - Sea Surface Temperature ($^{\circ}\text{C}$)

MLD - Surface Mixed Layer Depth (defined for water within 0.2°C of surface temp)

T₂₅₀ - Temperature field at 250 metres depth

DYN. HT - Dynamic Height (dbar wrt 1300 metres)

CROSS SECTION - Cross-section of isotherms ($^{\circ}\text{C}$) with depth (m)

TABLE I

S.S.T. vs T250 (OR DYNAMIC HEIGHT)

OCCASIONS WHEN A FEATURE WAS DISCERNABLE IN SST PATTERNS

Feature Date	Fig. Nos.	EAC down coast	EAC turning east	Eastern edge of EAC meander	Eddy	Eddy except North Side
Nov-Dec 60	1-4	yes & W.T.	no		-	yes
Sep-Oct 62	5 & 6	no	vaguely	vaguely	N.P.	
Sep 63	7 & 8		yes		yes	-
Nov 63	9 & 10	yes	yes	yes	N.P.	
Jan-Feb 64	11-14	very weakly	very weakly	vague	no	-
Mar 64	15 & 16	yes	diffuse		no	-
Aug 64	17 & 18	only W.T. up N.	yes	yes		
Sep 64	19-23	only broad W.T. up N.	yes	yes		
Nov 65	24 & 25	no	yes		no	-
Feb-Mar 77	26-27a	yes & W.T.	yes		no	-
Mar 77	28-29a	yes	yes		no	-
late Mar 77	30-31a				-	yes
Feb 78	32-34	yes & W.T.*	yes		yes	-
Mar 78	35-38	no	very weakly			
Apr 78	39-41	W.T. only	yes		no	-
May-June 78	42-45				-	yes & W.T. on N.
June 78	46-49	no	yes	yes		
Jul-Aug 78	50 & 51		yes			
Aug 78	52-54	W.T. up N. only	no	no	no	-
Sep 78	55-57	no	yes	no	-	yes
late Sep 78	58-61				no	
early Dec 78	62 & 63				-	yes

TABLE I CONT.

OCCASIONS WHEN A FEATURE WAS DISCERNABLE IN SST PATTERNS

Feature Date	Fig. Nos.	EAC down coast	EAC turning east	Eastern edge of EAC meander	Eddy	Eddy except North Side
Dec 78	64-66	no	yes	no		
Feb 79	67-69	no	yes	no		
Mar 79	70 & 71	no	yes			
May 79	72-75	weak & W.T.				
May-June 79	76-79				-	yes
July 79	80 & 81	no	no		yes	-
Aug 79	82-84				-	yes
Sep-Oct 79	85 & 86				yes	-
Oct 79	87 & 88				-	yes
Feb 80	89-91				no	-
Apr 80	92-94	weak				
July 80	95-97		yes		yes (2 present)	-

* EAC further offshore than normal in this case.

Notes: W.T. \equiv warm tongue,

N. \equiv North.

A blank signifies that a feature was not surveyed.

N.P. \equiv feature not present.

- signifies eddy observations are in alternative criterion.

TABLE II

PERCENTAGE OF OCCASIONS ON WHICH A DISCERNABLE FEATURE DETECTED IN SST PATTERNS

Feature	EAC down coast	EAC turning east	east edge of meander	eddy
%	59	83	70	59

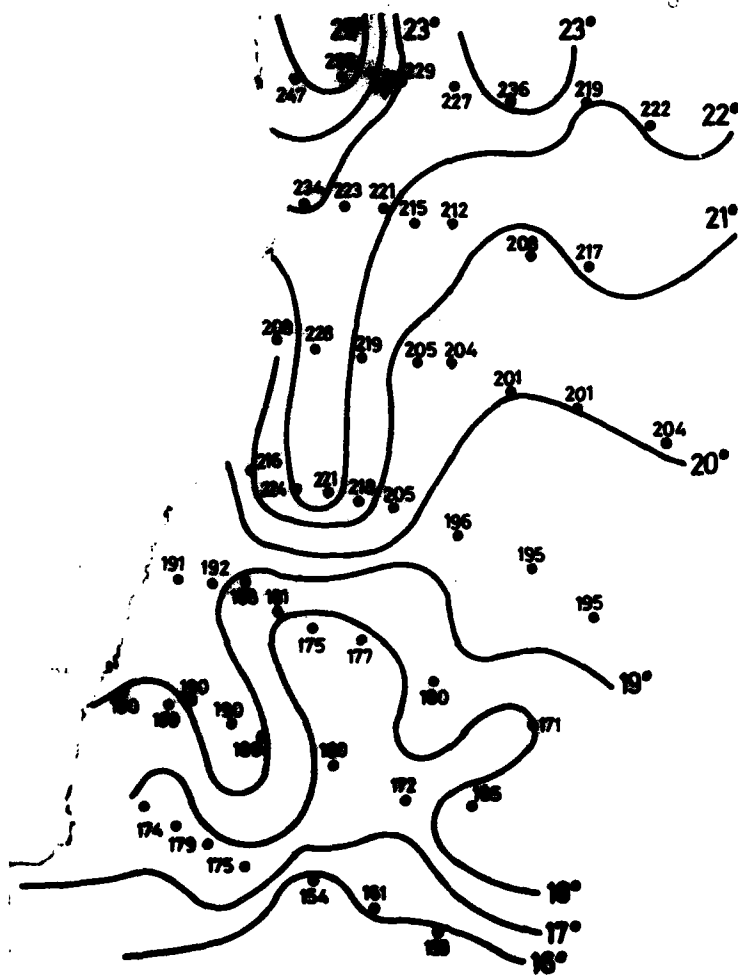
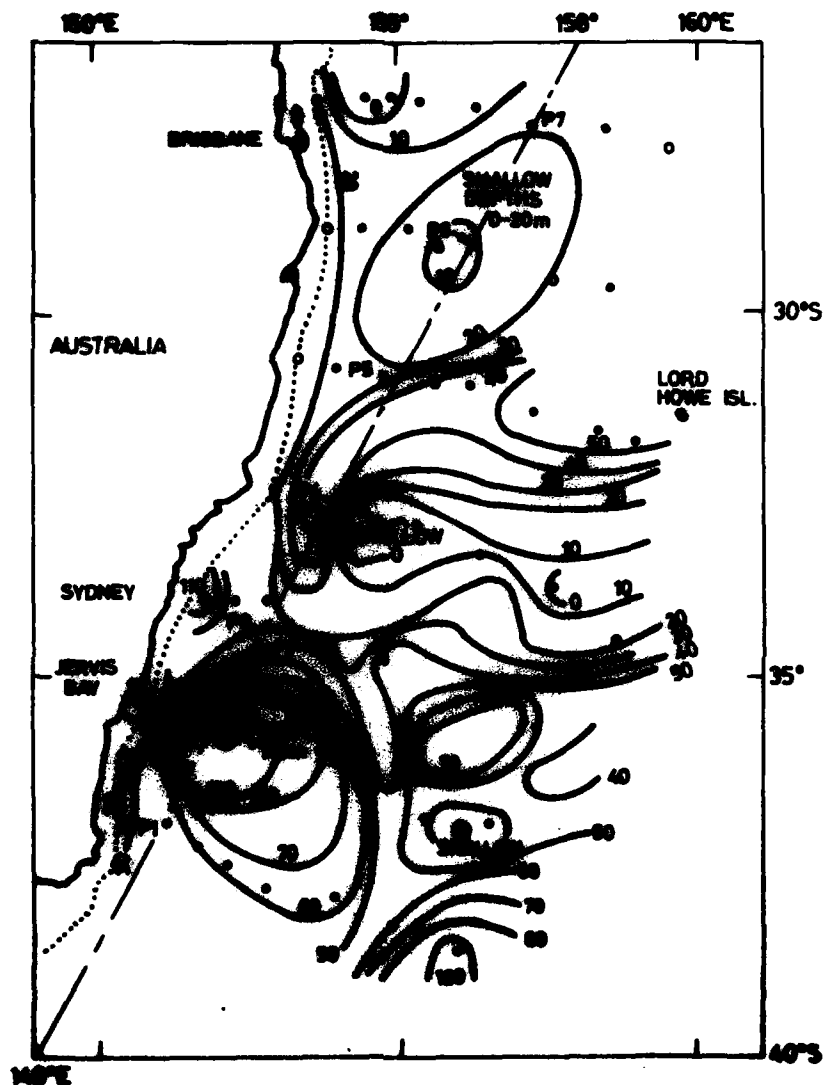


Fig. 1. SST. G 3/60. Nov. - Dec. 1960.

TABLE III

SEASONAL VARIATION IN DISCERNABILITY OF AN EDDY IN SST PATTERN

Months	Dec-Feb	Mar-May	June-Aug	Sept-Nov
% of occasions on which discernable:	25	30	80	70
No. of cruises:	4	7	5	7



**Fig.2 Surface mixed layer depth for cruise G3/80
(Nov. 8 - Dec. 4, 1980).**

A CROSS-SECTION OF ISOTHERMS VERSUS DEPTH WAS CONSTRUCTED
ALONG THE DASHED LINE, USING BATHYTHERMOGRAPH RESULTS AT
POINTS P1 TO P7.

THE SURFACE MIXED LAYER DEPTH IS DEFINED BY VERTICAL MIXING
0-2°C OF THE SURFACE TEMPERATURE.

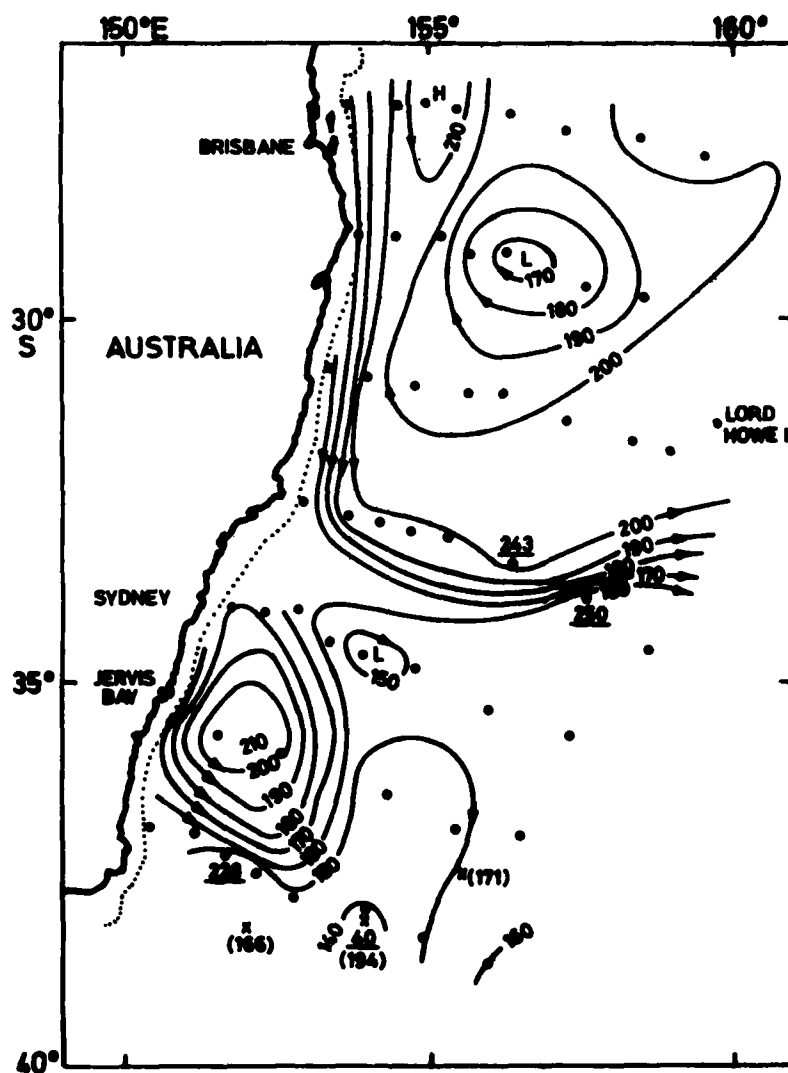


Fig.3. Surface dynamic topography, relative to 1300 decibars, for Cruise G3/60 (Nov. 8 - Dec. 4, 1960).

- Stations with sampling to at least 1300m.
- Stations with sampling to less than 1300m.
- Three stations on Cruise G1/61, with dynamic heights in brackets.

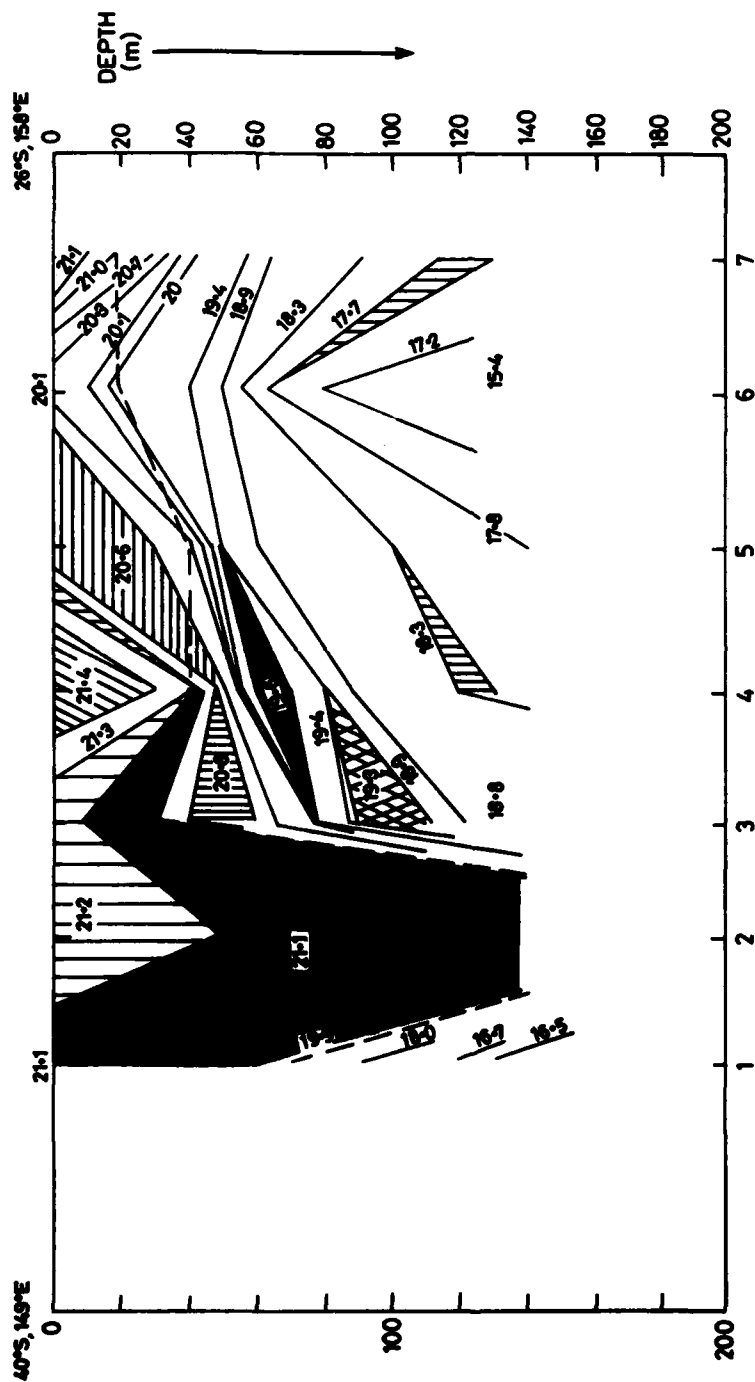


Fig. 4. Cross-section of temperature isotherms ($^{\circ}\text{C}$) versus depth (m) for cruise G3/60 (Nov. 8 - Dec. 4, 1960).

AN EDDY IS CENTRED AROUND REFERENCE POINT 2.

DASHED LINE SHOWS SURFACE MIXED LAYER DEPTH (WATERS WITHIN 0.2°C OF SURFACE TEMPERATURE).

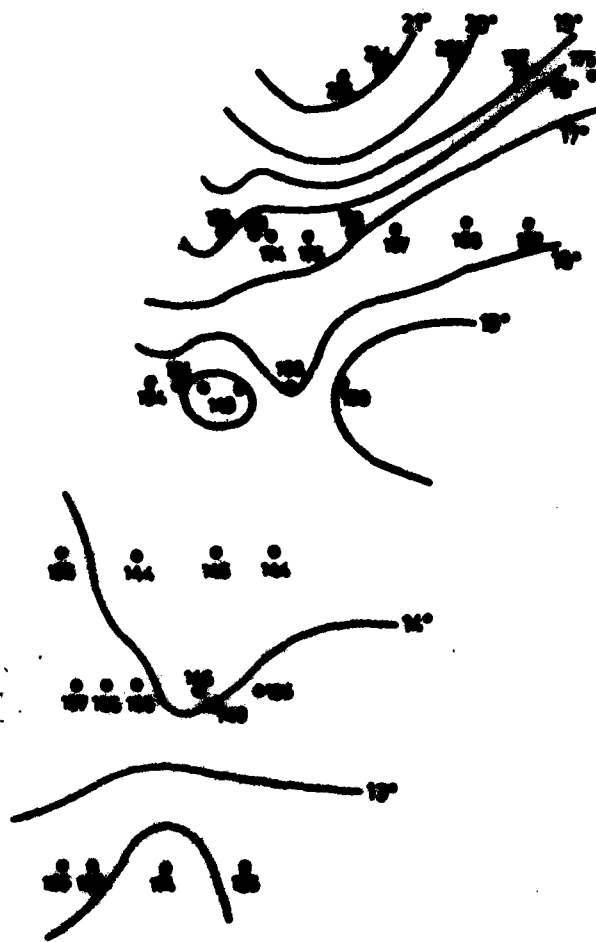


Fig 5.98T. 06/62. Sept /Oct. 1962.

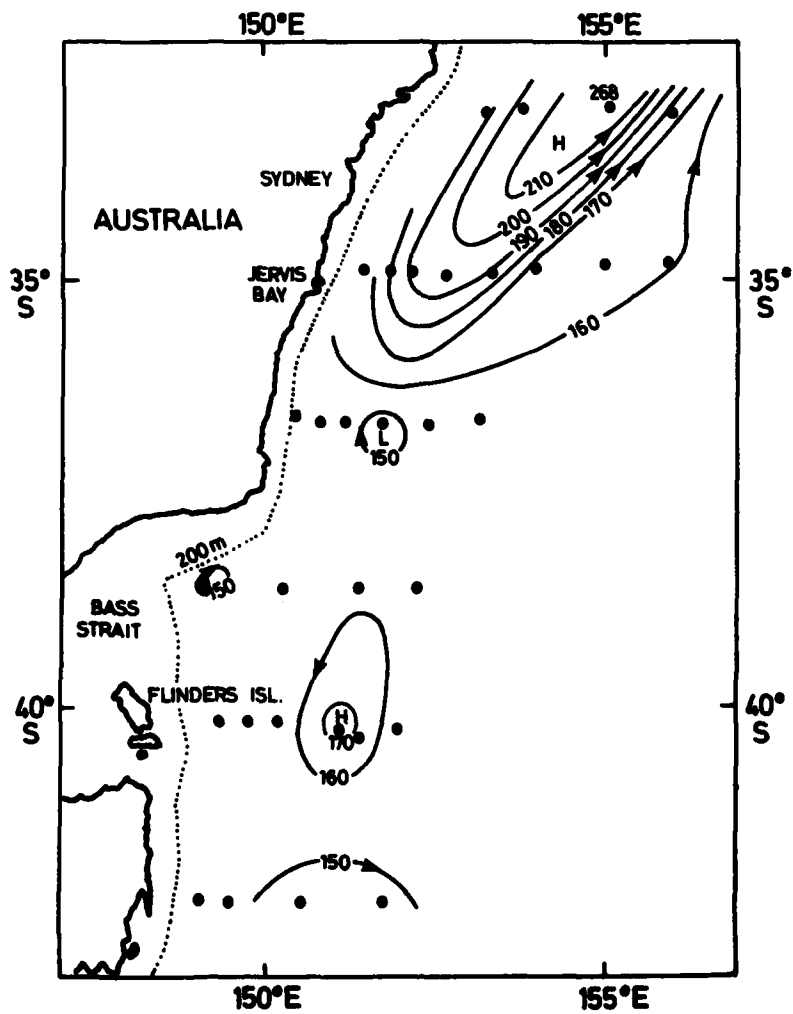


Fig.6. Surface dynamic topography, relative to 1300 decibars, for Cruise G5/62 (Sept. 30 - Oct. 10, 1962)

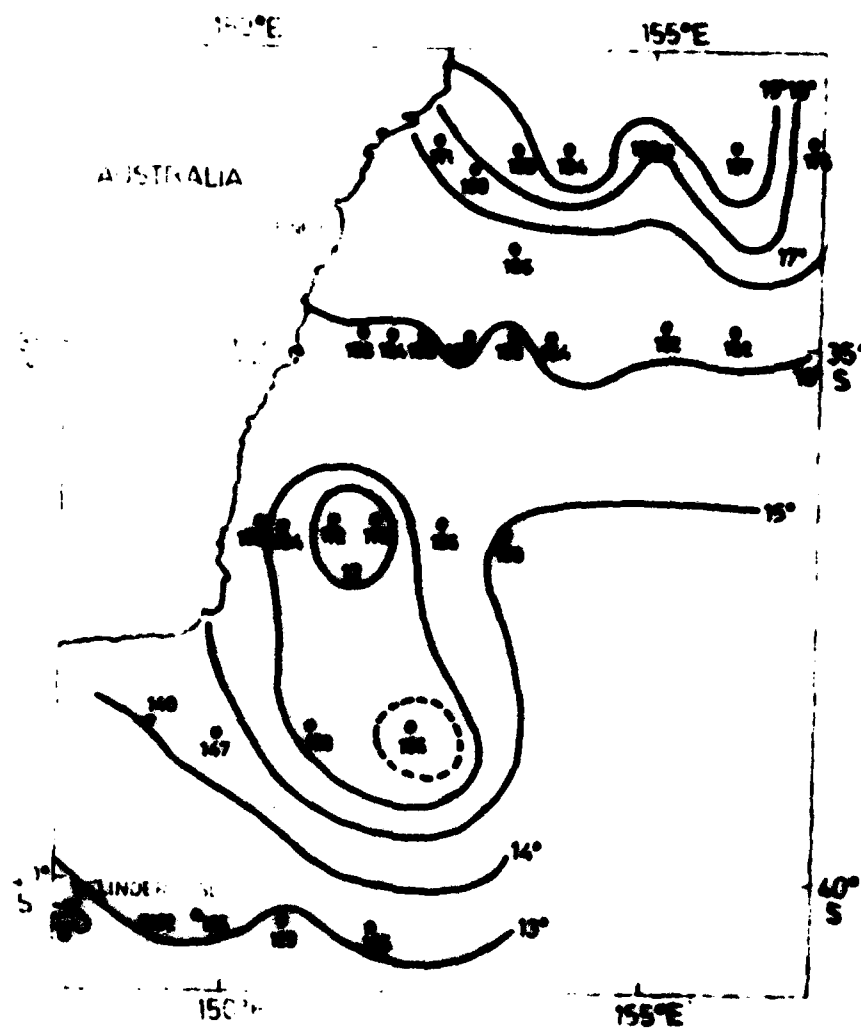


Fig. 7. SST. 64/63. Sept. 1963.

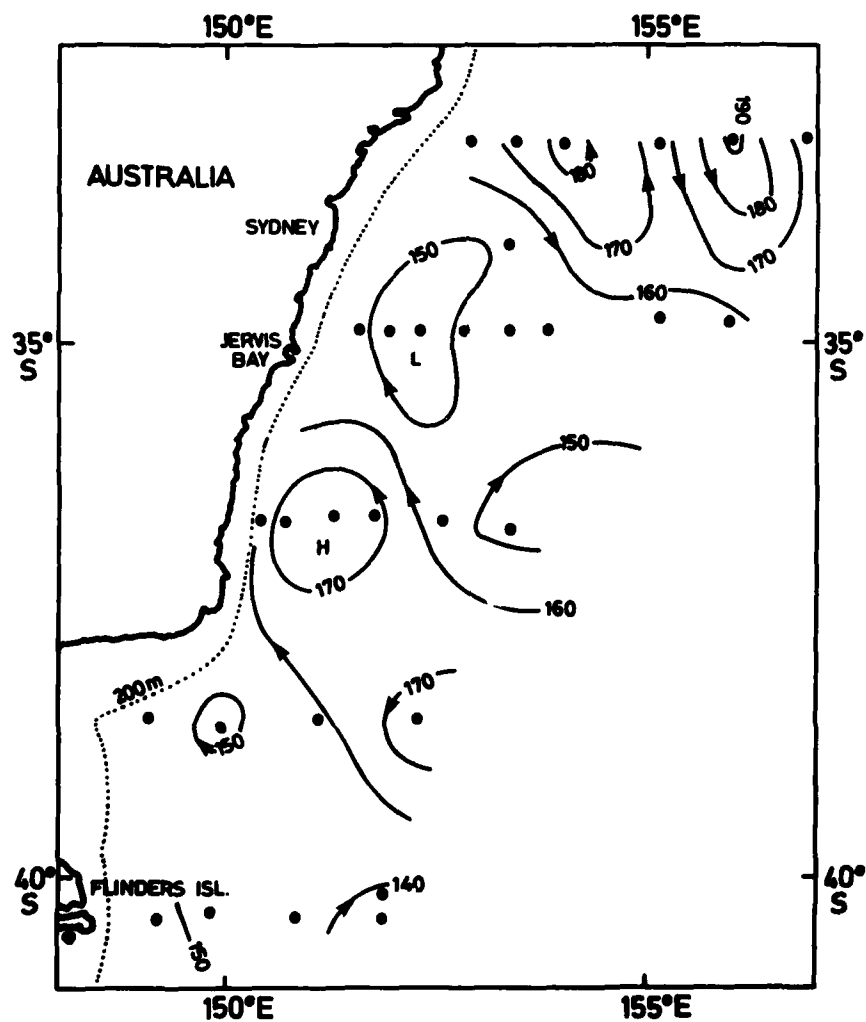


Fig.8. Surface dynamic topography, relative to 1300 decibars, for Cruise G4/63 (September 9-18, 1963)

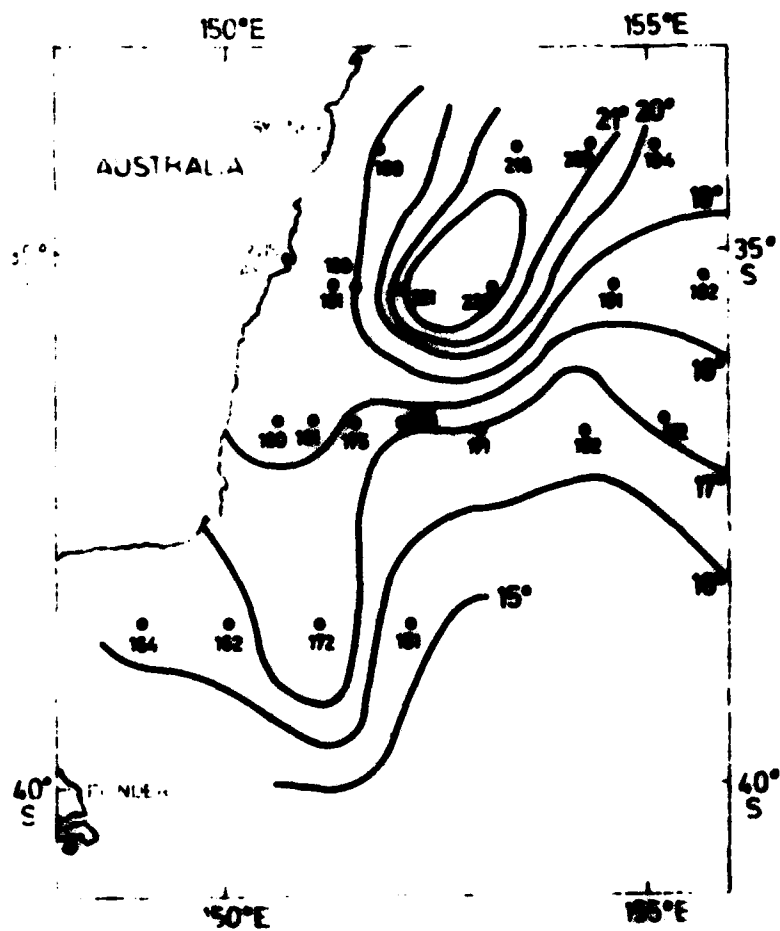


Fig. 9. SST. G5/63. Nov. 1963.

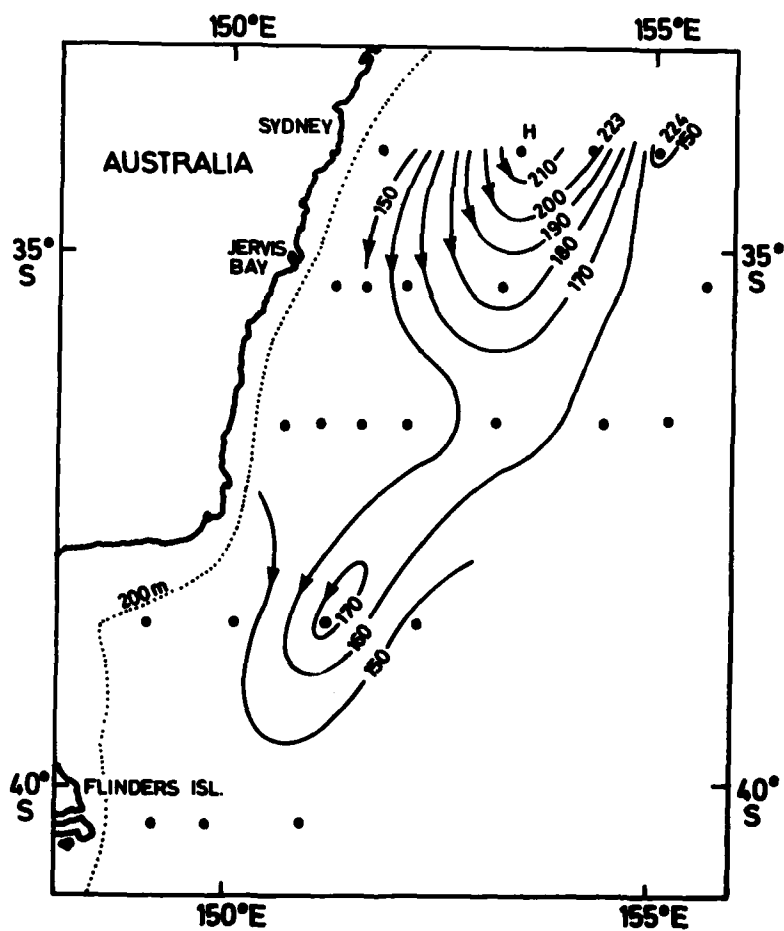


Fig.10. Surface dynamic topography, relative to 1300 decibars, for Cruise G5/63 (November 7-15, 1963)

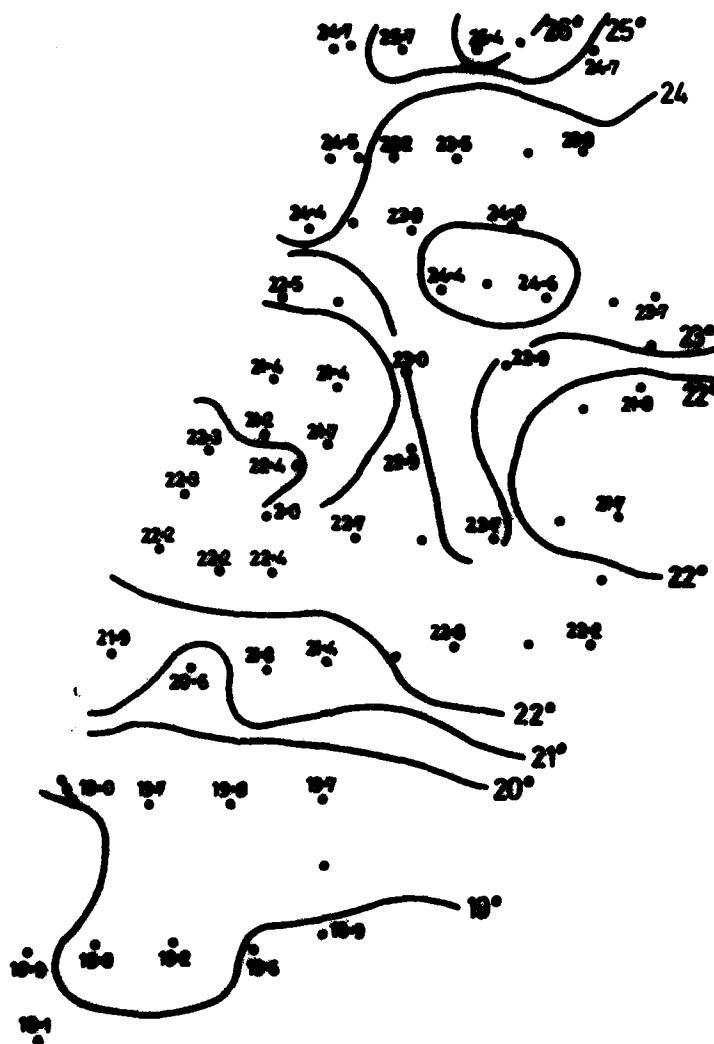
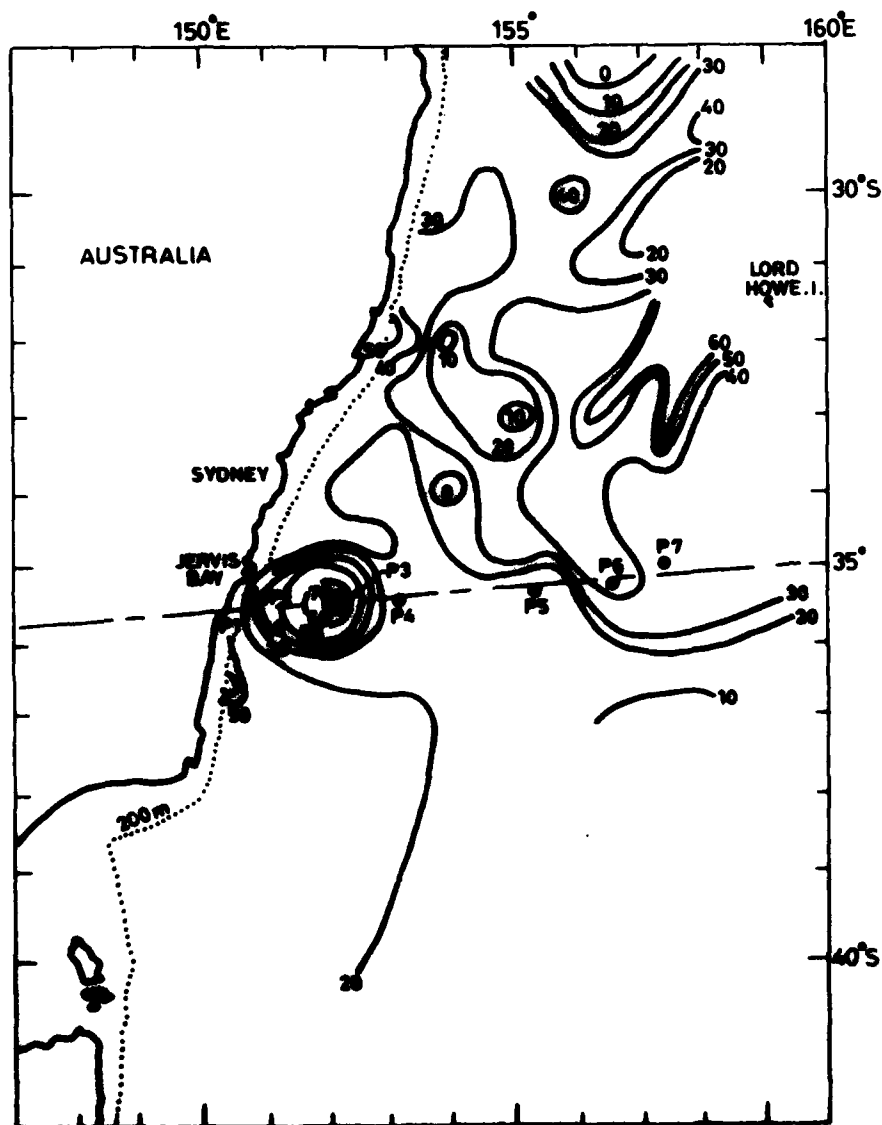


Fig. 11. SST. 01/64. Jan. - Feb. 1964.



**Fig.12 Surface mixed layer depth for cruise G1/64
(Jan. 13 - Feb. 6, 1964).**

A CROSS-SECTION OF ISOTHERMS VERSUS DEPTH WAS CONSTRUCTED ALONG THE DASHED LINE, USING BATHYTHERMOGRAPH RESULTS AT POINTS P1 TO P7.

THE SURFACE MIXED LAYER DEPTH IS DEFINED BY WATERS WITHIN 0.2°C OF THE SURFACE TEMPERATURE.

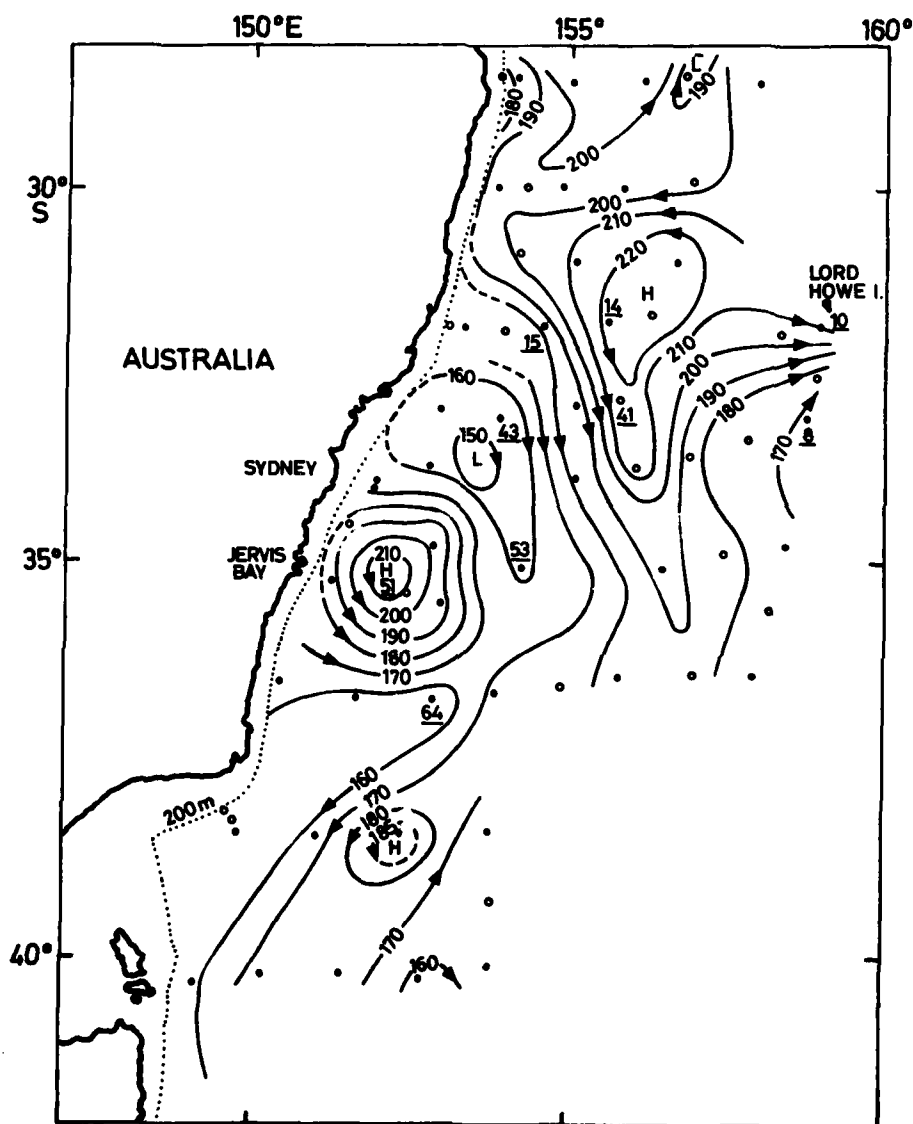


Fig.13. Surface dynamic topography, relative to 1300 decibars, for Cruise G1/64 (Jan. 13 - Feb. 6, 1964).

- Stations with sampling to at least 1300 m.
- Bathythermograph stations to 285 m.

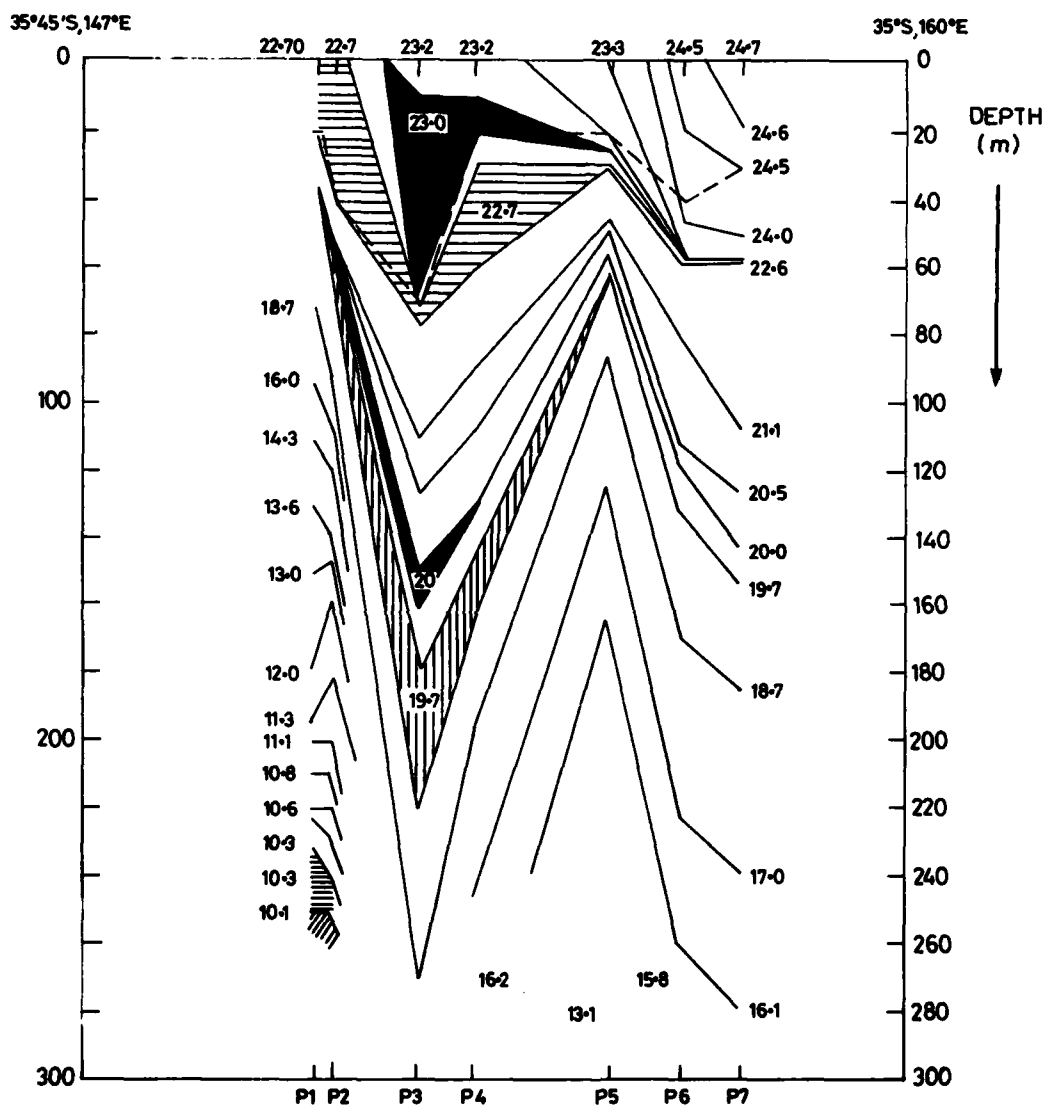


Fig.14. Cross-section of isotherms verses depth for cruise G/64 (Jan. 13 – Feb. 6, 1964).

DASHED LINE SHOWS SURFACE MIXED LAYER DEPTH (WATERS WITHIN 0.2°C OF SURFACE TEMPERATURE).

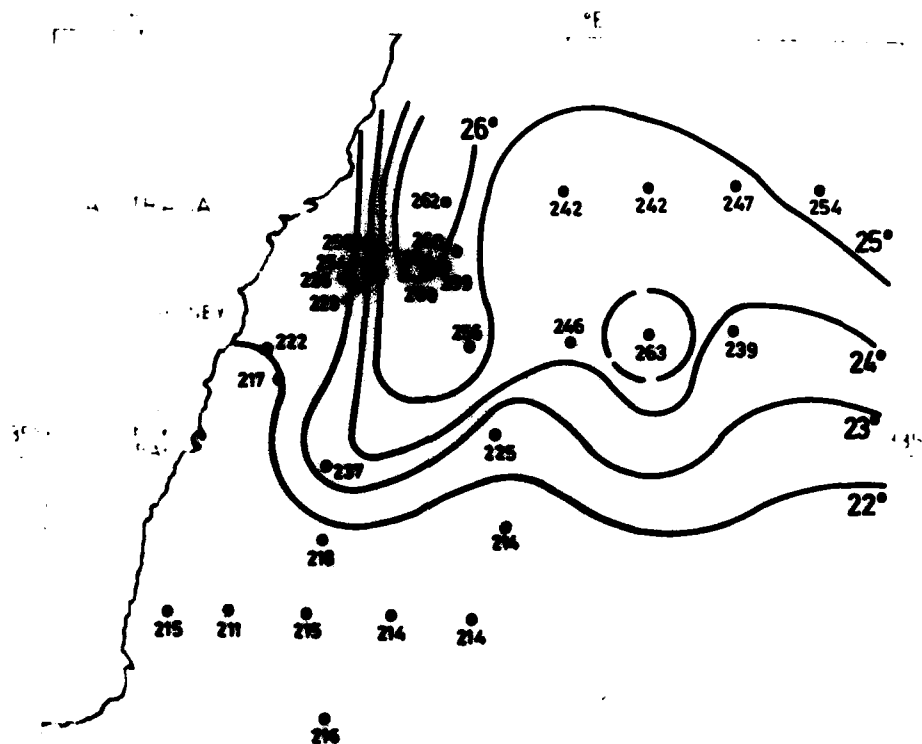


Fig. 15. SST. G3/64. Mar. 1964.

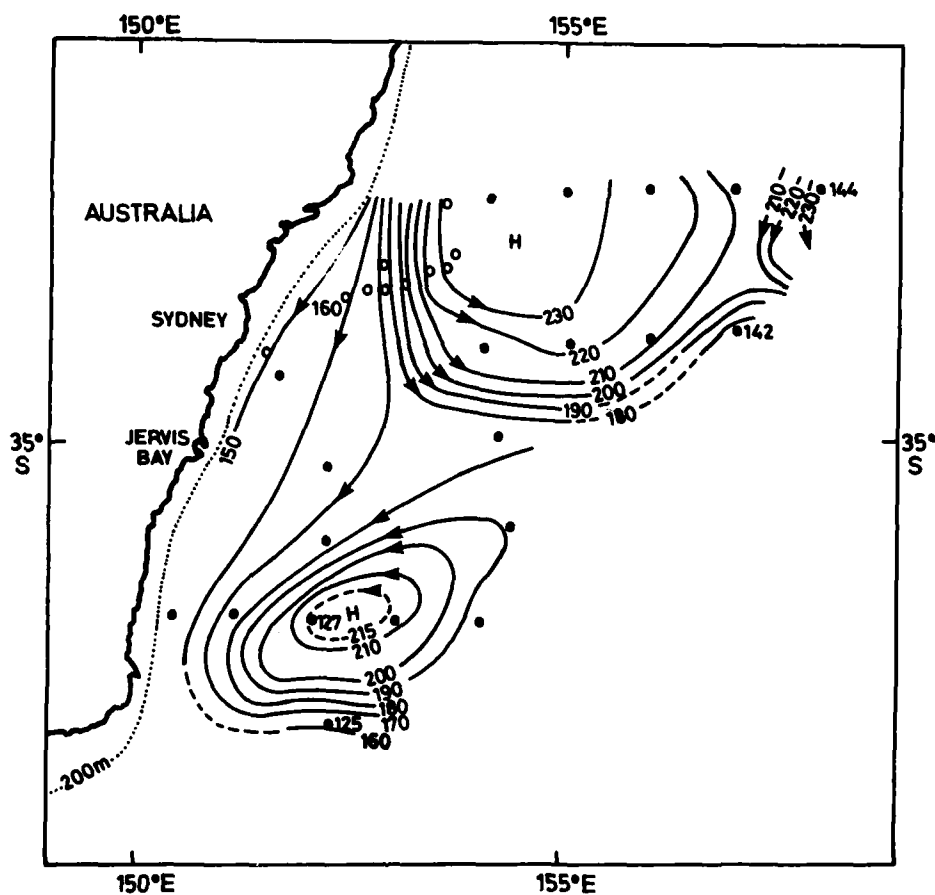


Fig.16. Surface dynamic topography, relative to 1300 decibars, for Cruise G3/64 March 18-25, (1964)

- Stations with sampling to at least 1300 m.
- Bathythermograph stations to 285 m.

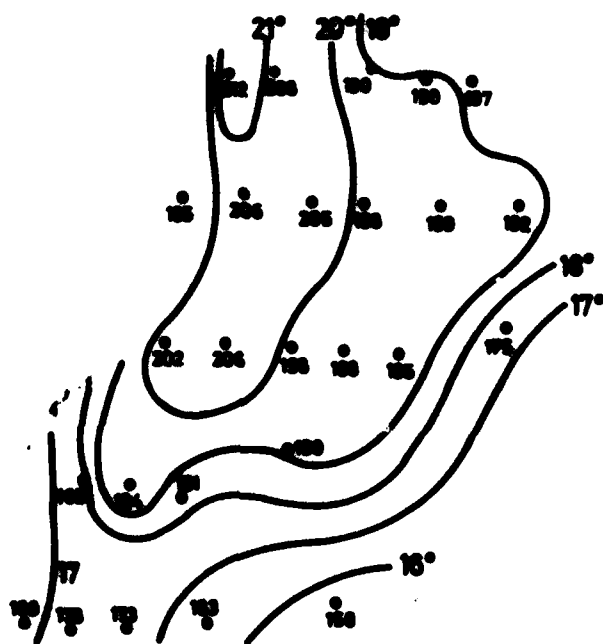


Fig.17. SST. 4/64. Aug.1964.

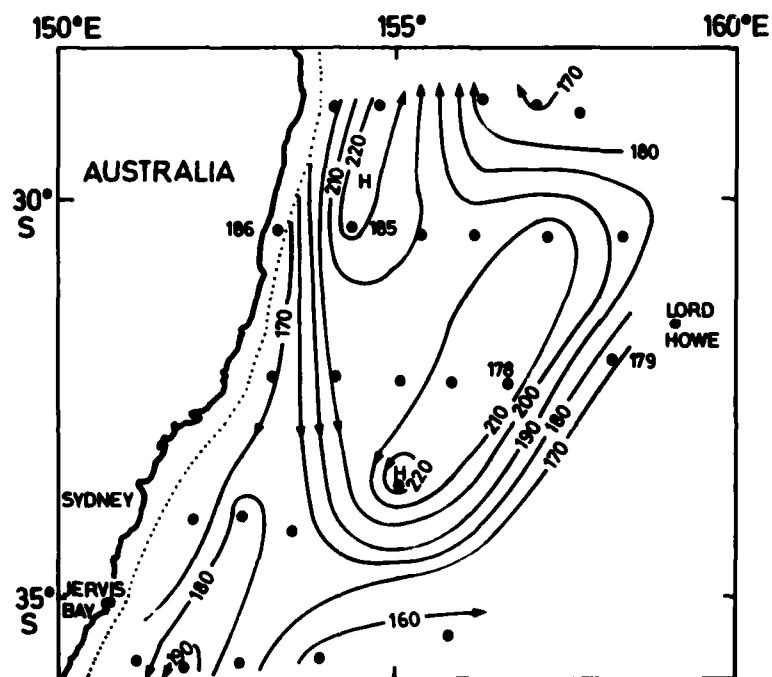


Fig.18 Surface dynamic topography, relative to 1300 decibars, for Cruise G4/64. (Aug. 3-13, 1964)

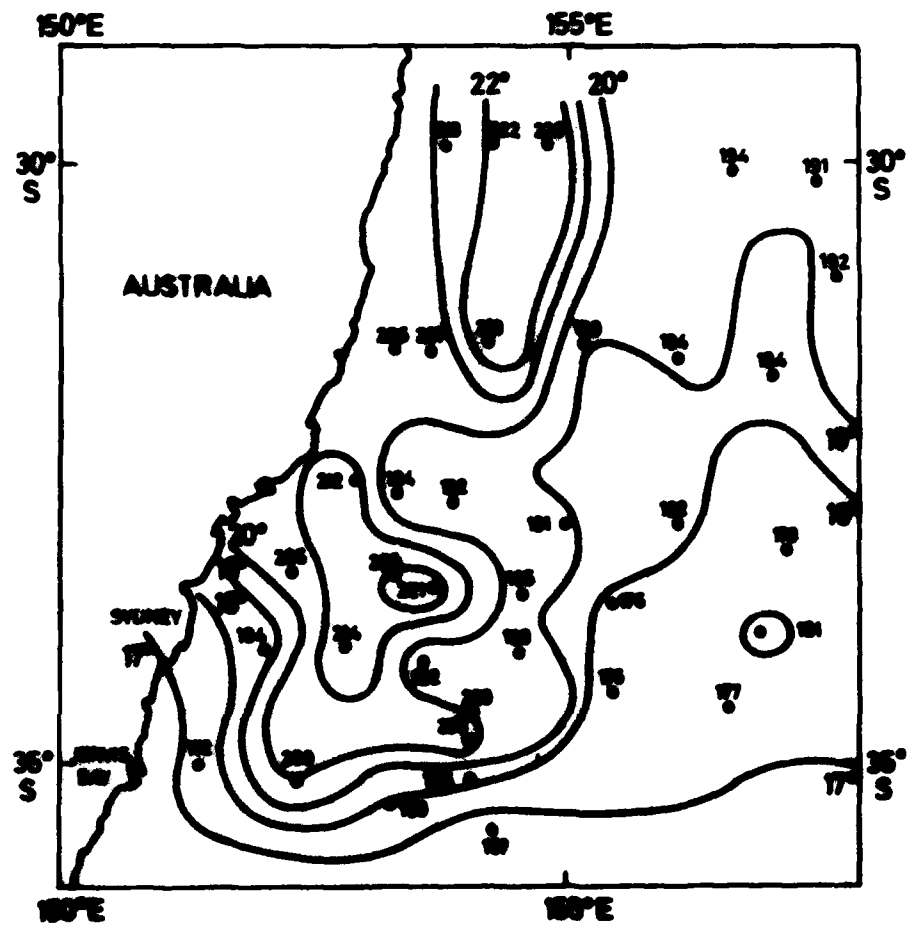


Fig. 10. SST. G6/64. Sept. 1964.

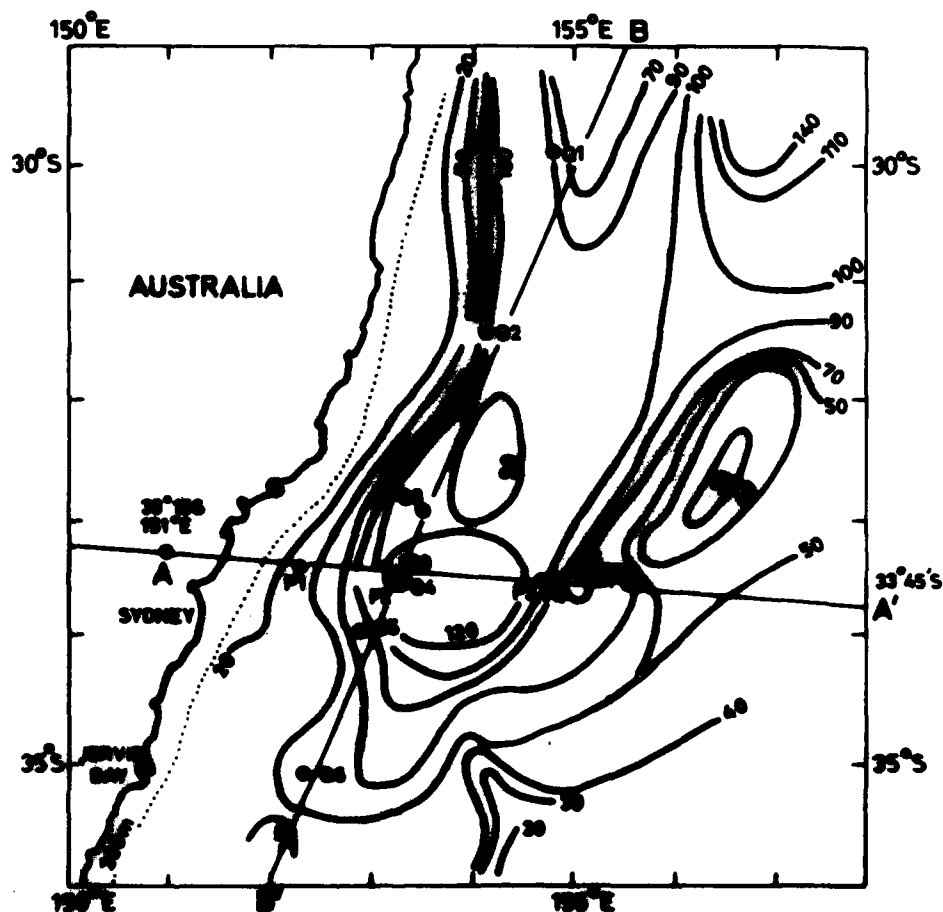


Fig. 22. Surface mixed layer depth for cruise G6/64 (Sept. 16 - 27, 1964).

CROSS-SECTIONS OF ISOTHERMS VERSUS DEPTH WERE
CONSTRUCTED ALONG A-A' AND B-B'.
THE MIXED LAYER DEPTH IS DEFINED BY WATERS WITHIN
0-2°C OF THE SURFACE TEMPERATURE.

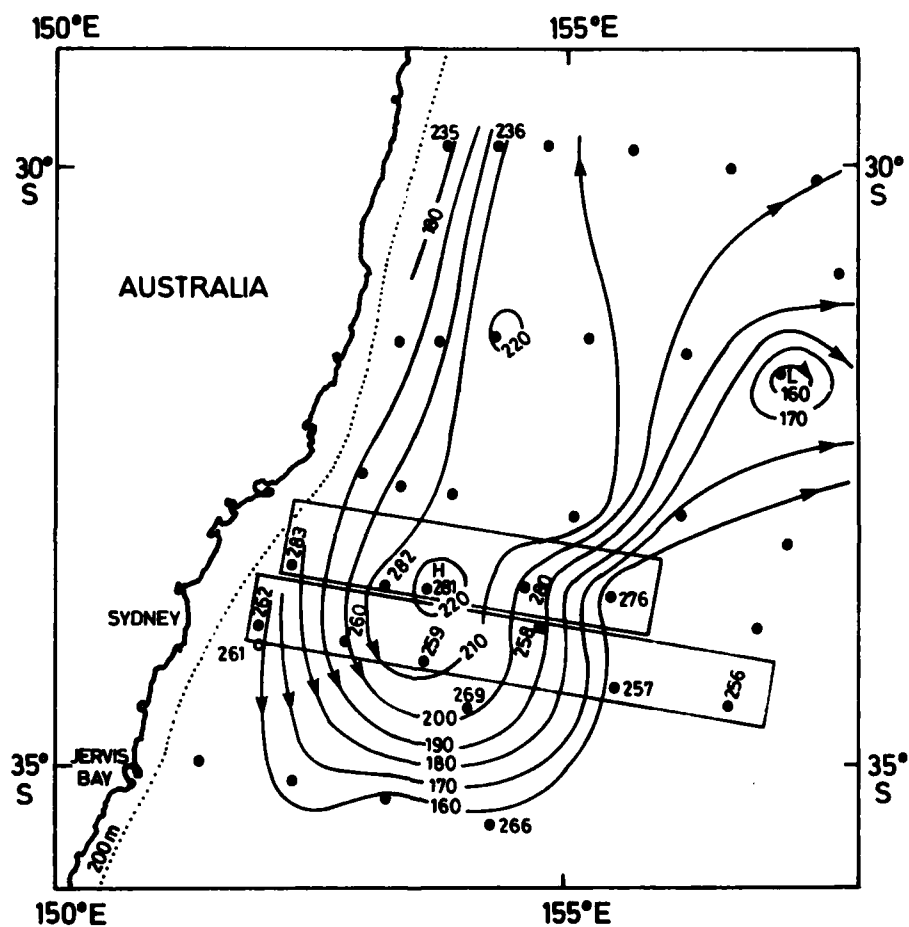


Fig.21. Surface dynamic topography, relative to 1300 decibars, for Cruise G 6/64 (Sept. 16-27, 1964)

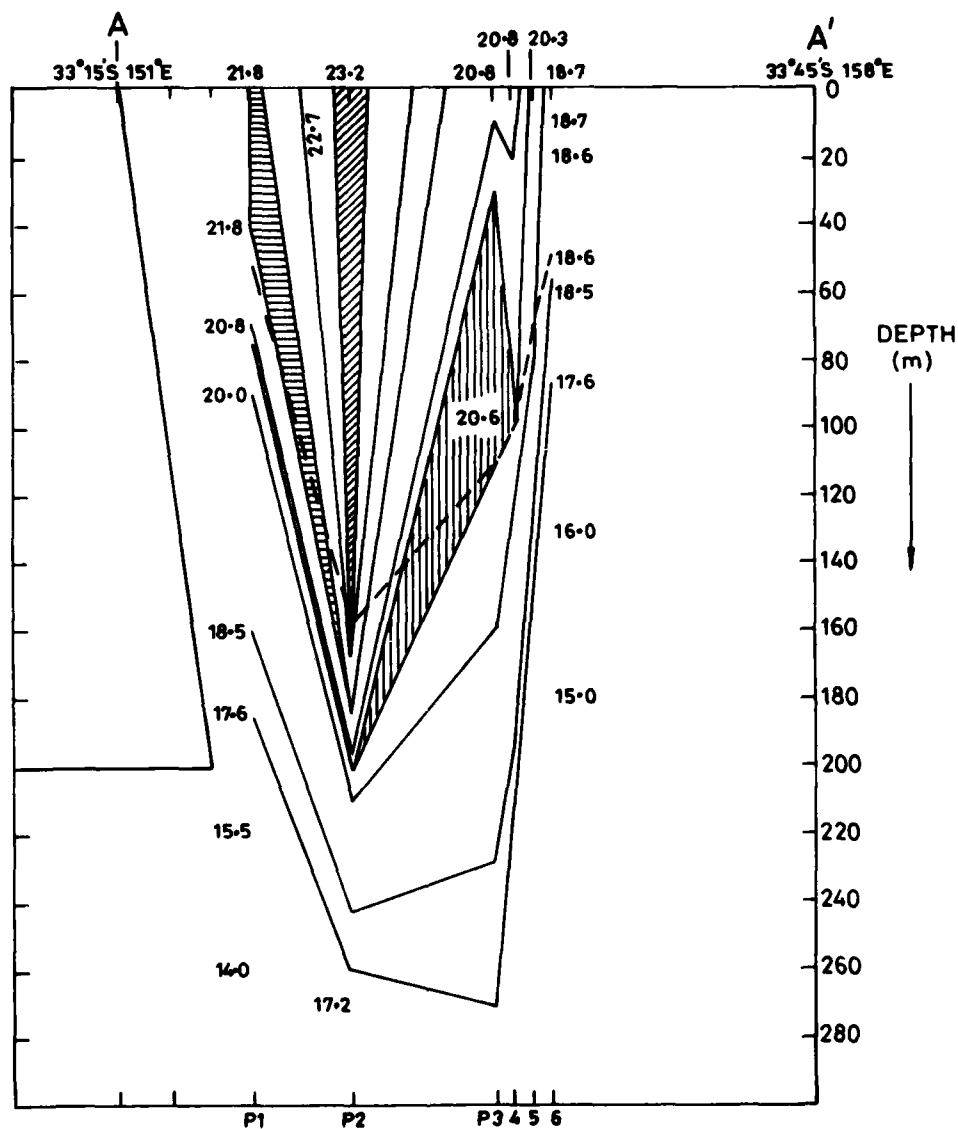


Fig.22. Cruise G6/64 (Sept. 16-27, 1964).

ISOTHERMS (°C) VERSUS DEPTH (m).

DASHED LINE SHOWS MIXED LAYER DEPTH (WATERS
WITHIN 0.2°C OF SURFACE TEMPERATURE).

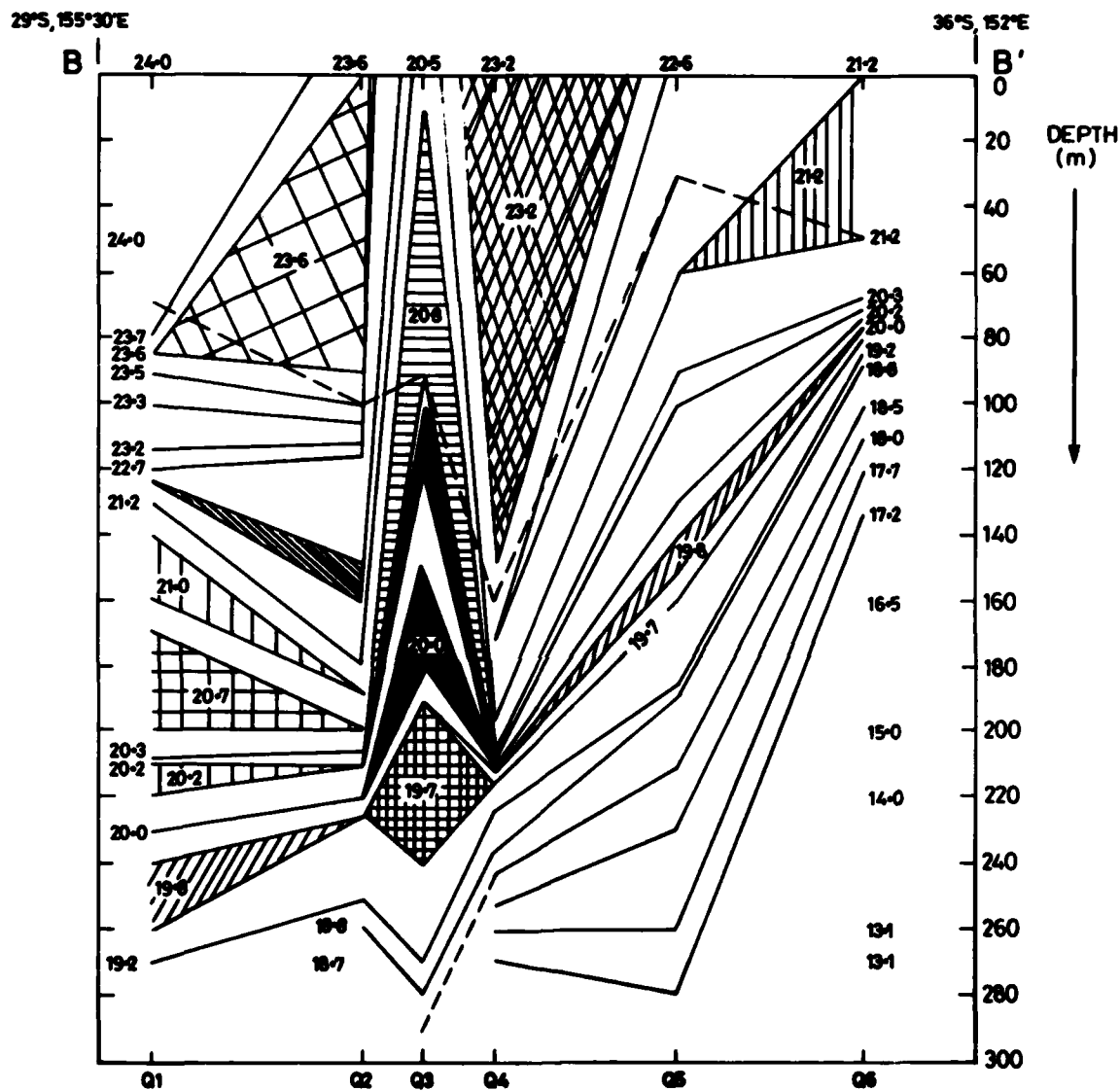


Fig. 23. Cruise G6/64 (Sept. 16-27, 1964).

ISOTHERMS (°C) VERSUS DEPTH (m).

DASHED LINE SHOWS MIXED LAYER DEPTH (WATERS
 WITHIN 0-2°C OF SURFACE TEMPERATURE).

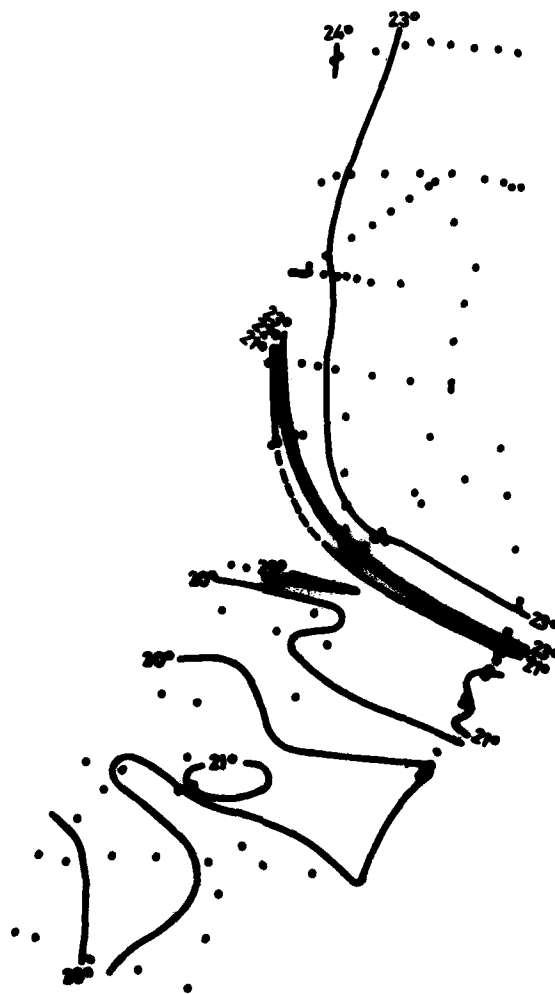


Fig. 24. SST G 8/85. Nov. 1985.

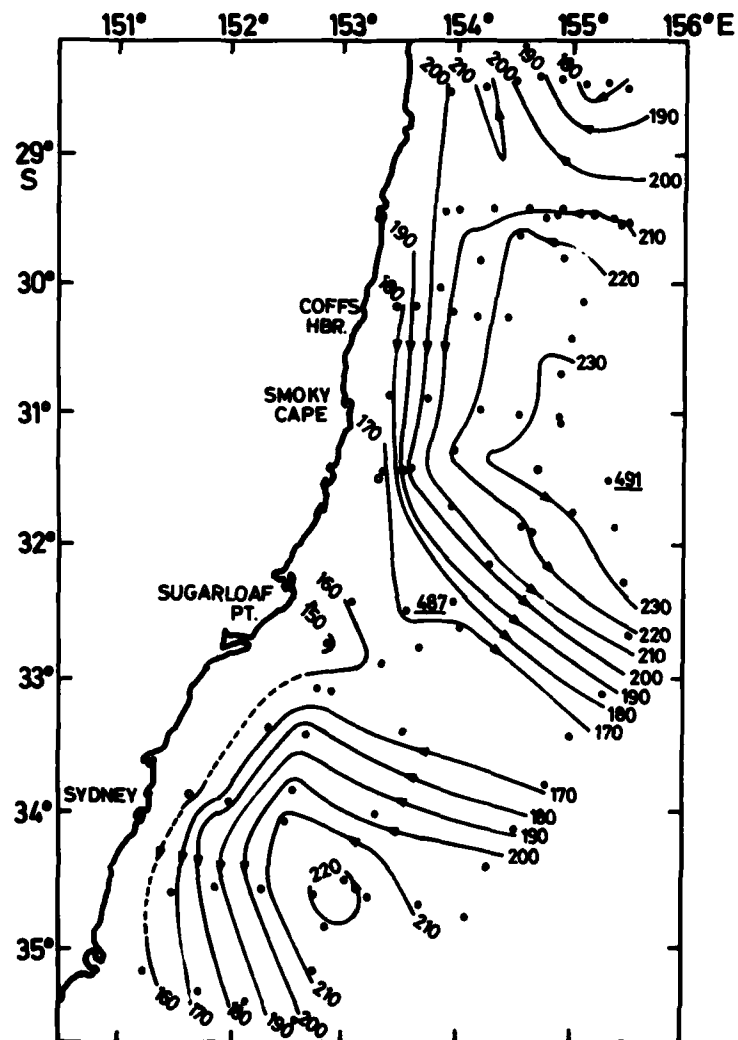


Fig.25. Surface dynamic topography relative to 1300 dbar for Cruise G9/65 (Nov.15-28, 1965).
 • stations with sampling to 1300 m.
 • bathythermograph stations to 280 m.

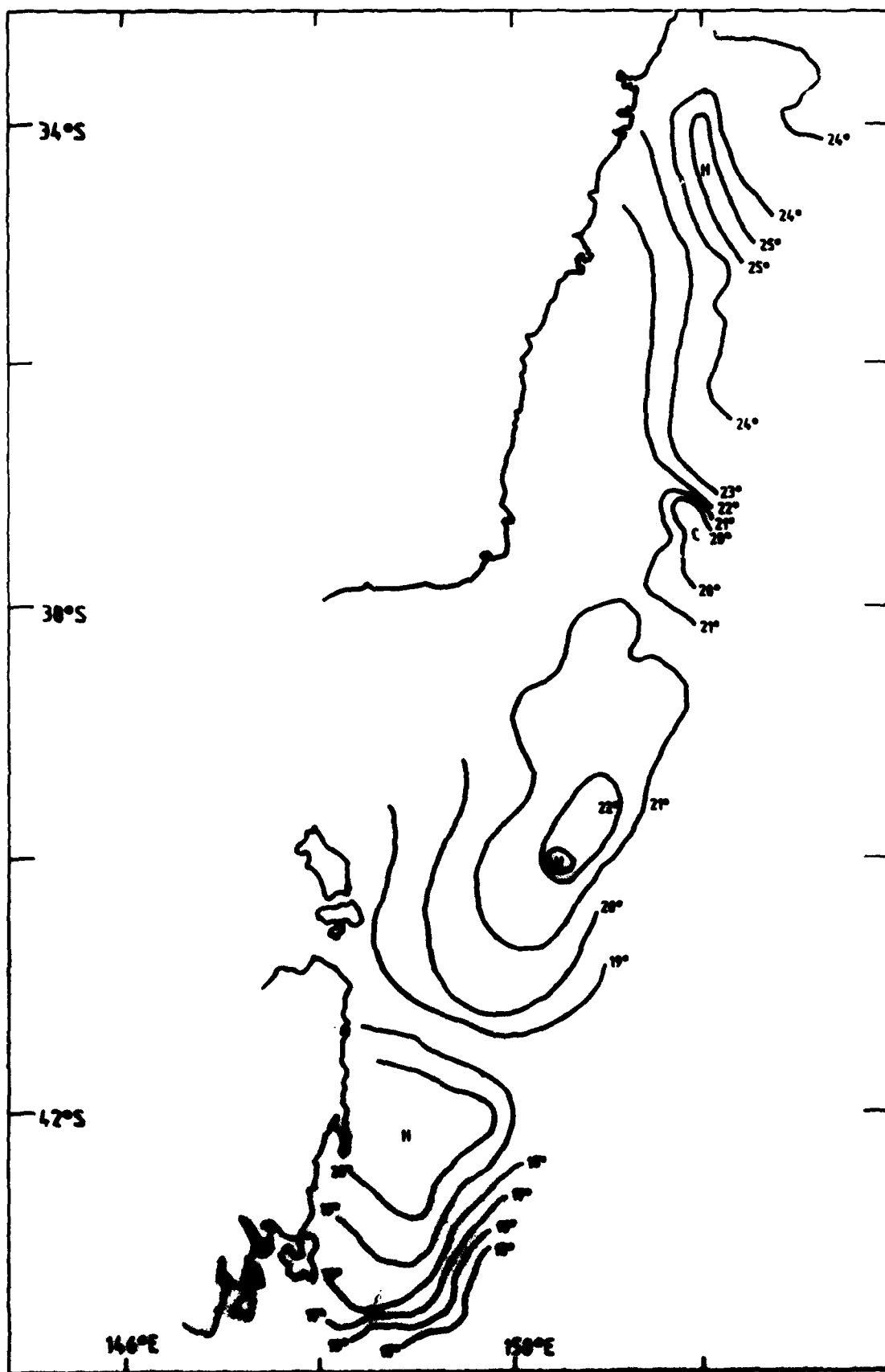


Fig. 26. K3/77/1 Sea surface temperature 28 Feb-7 Nov. 1977.

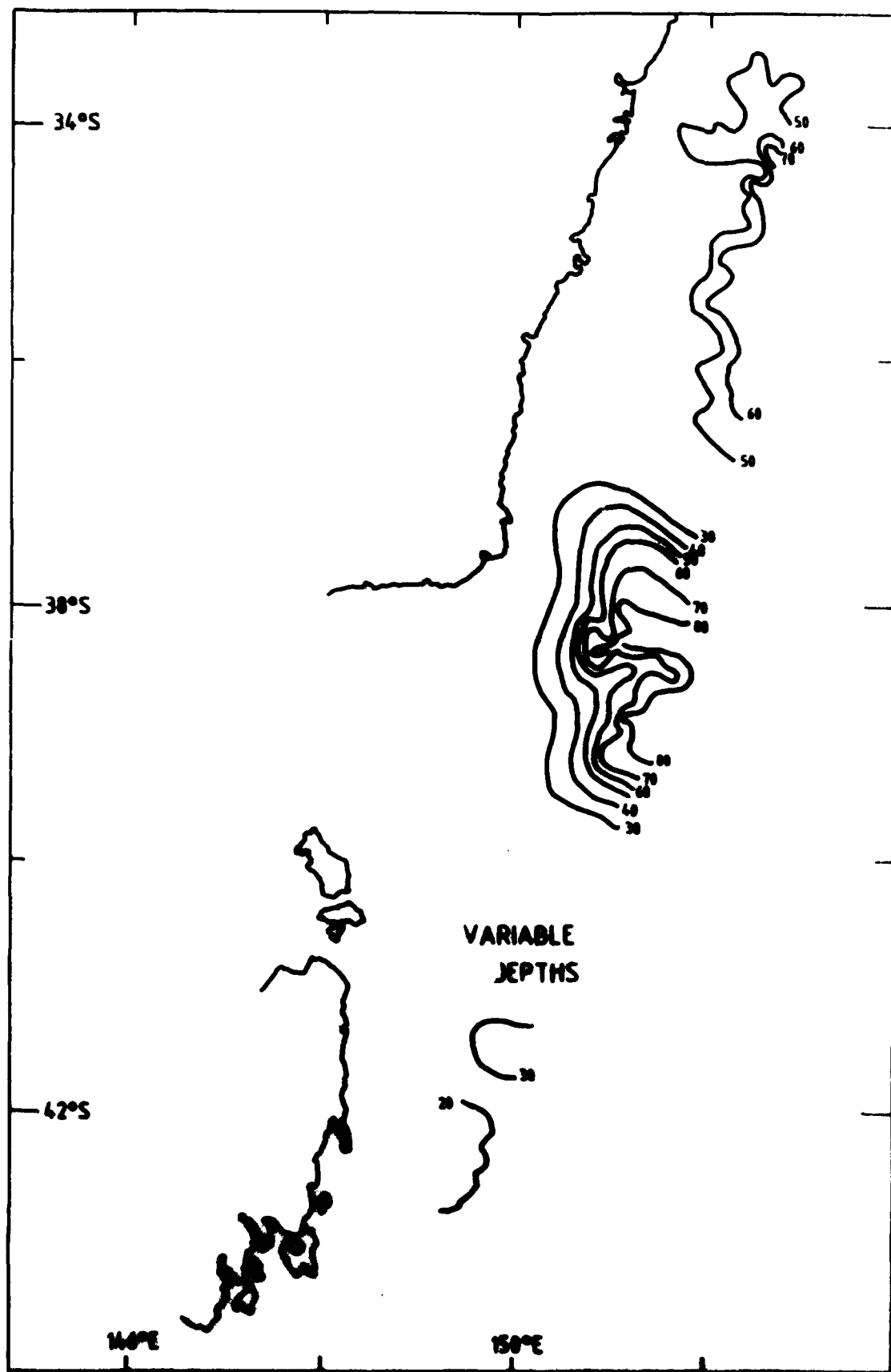


Fig. 27. K3/77/1 Mixed layer depth 28 Feb. 7 Mar. 1977

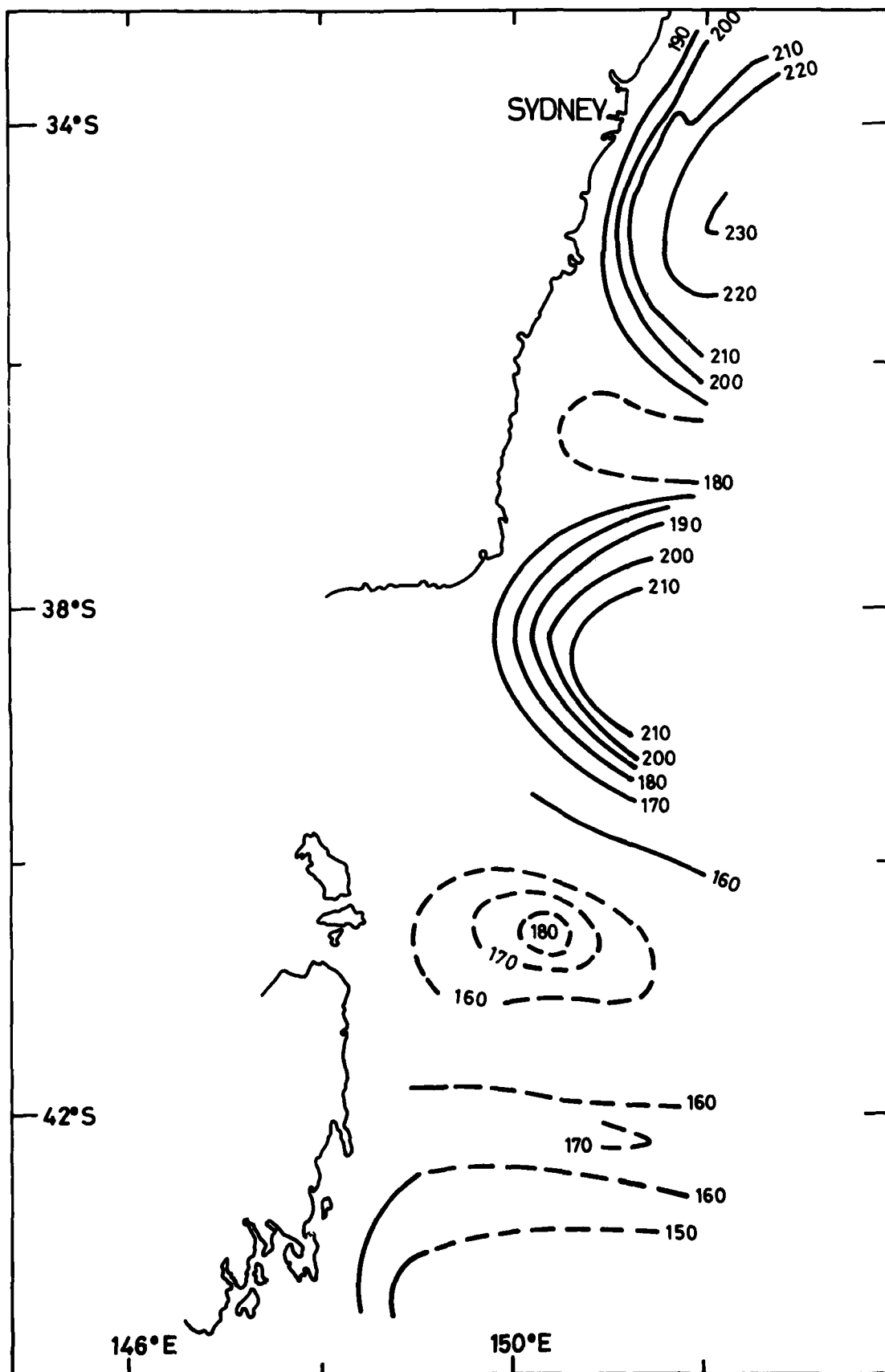


Fig. 27a. K3/77/1 Dynamic Height 28 Feb. 7 March 1977.

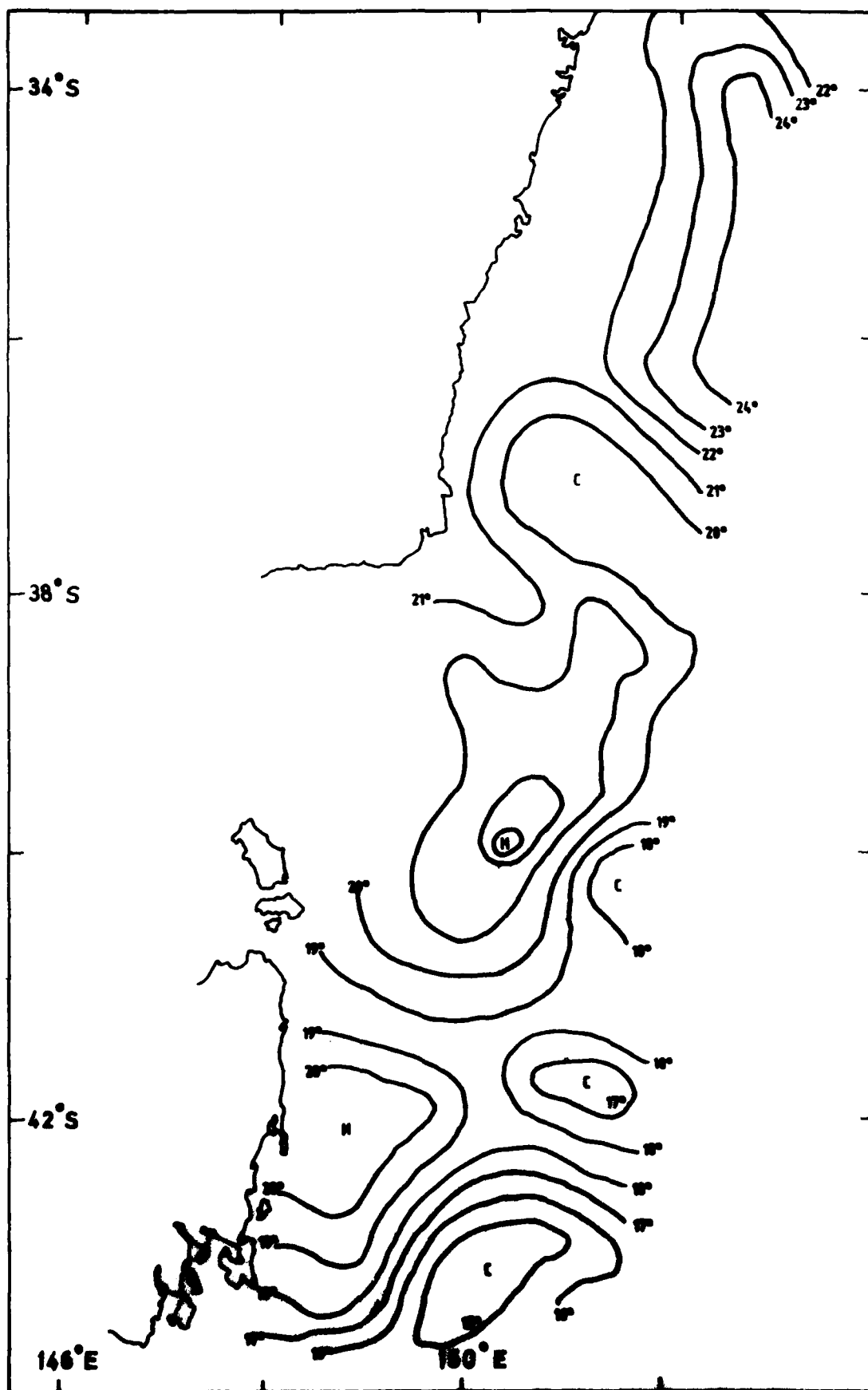


Fig. 28. Sea surface temperature K3/77/2 13-17 March 1977

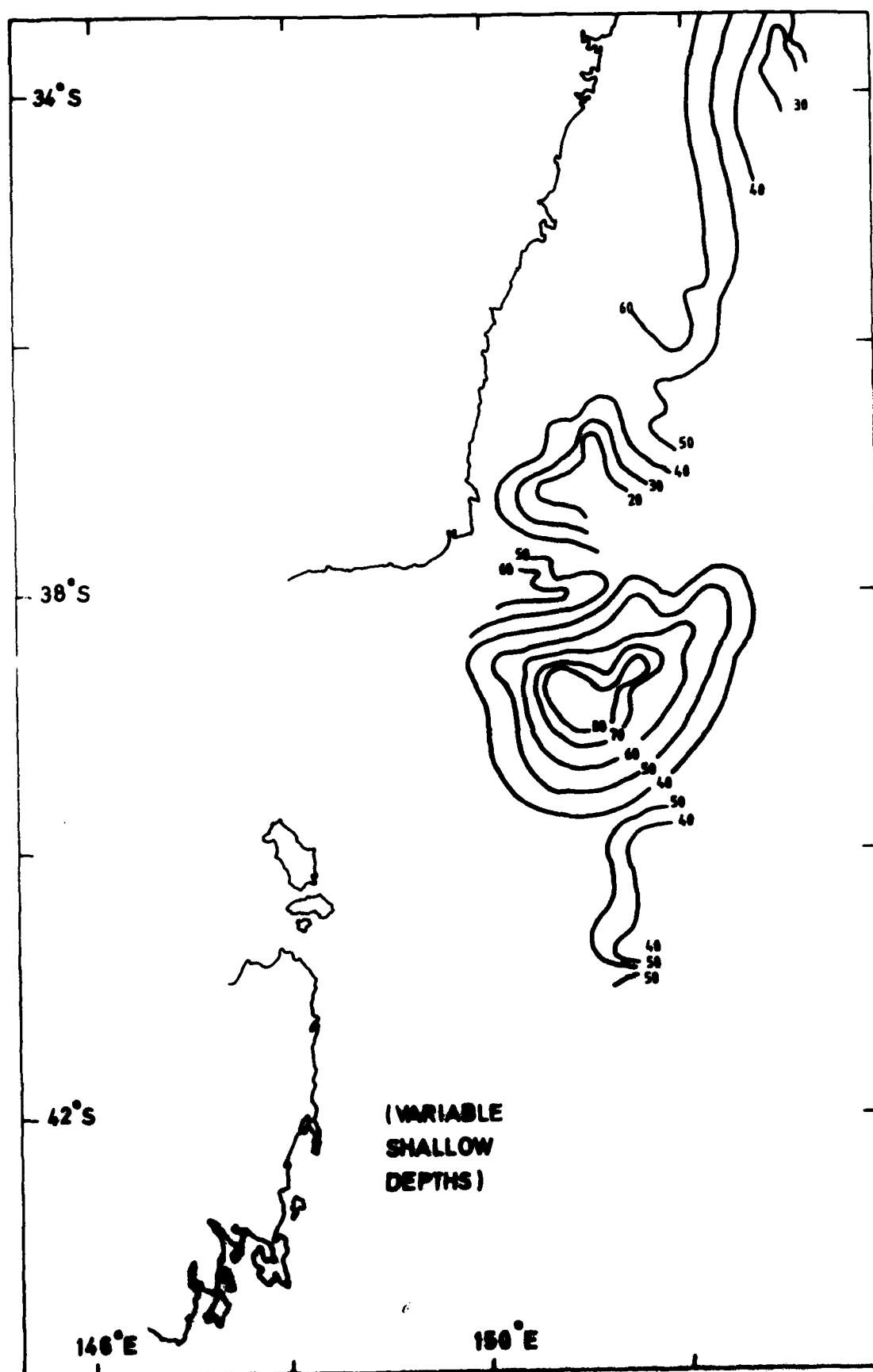


Fig.29. Mixed Layer Depth. K3/TN2. 13-17 March 1977.

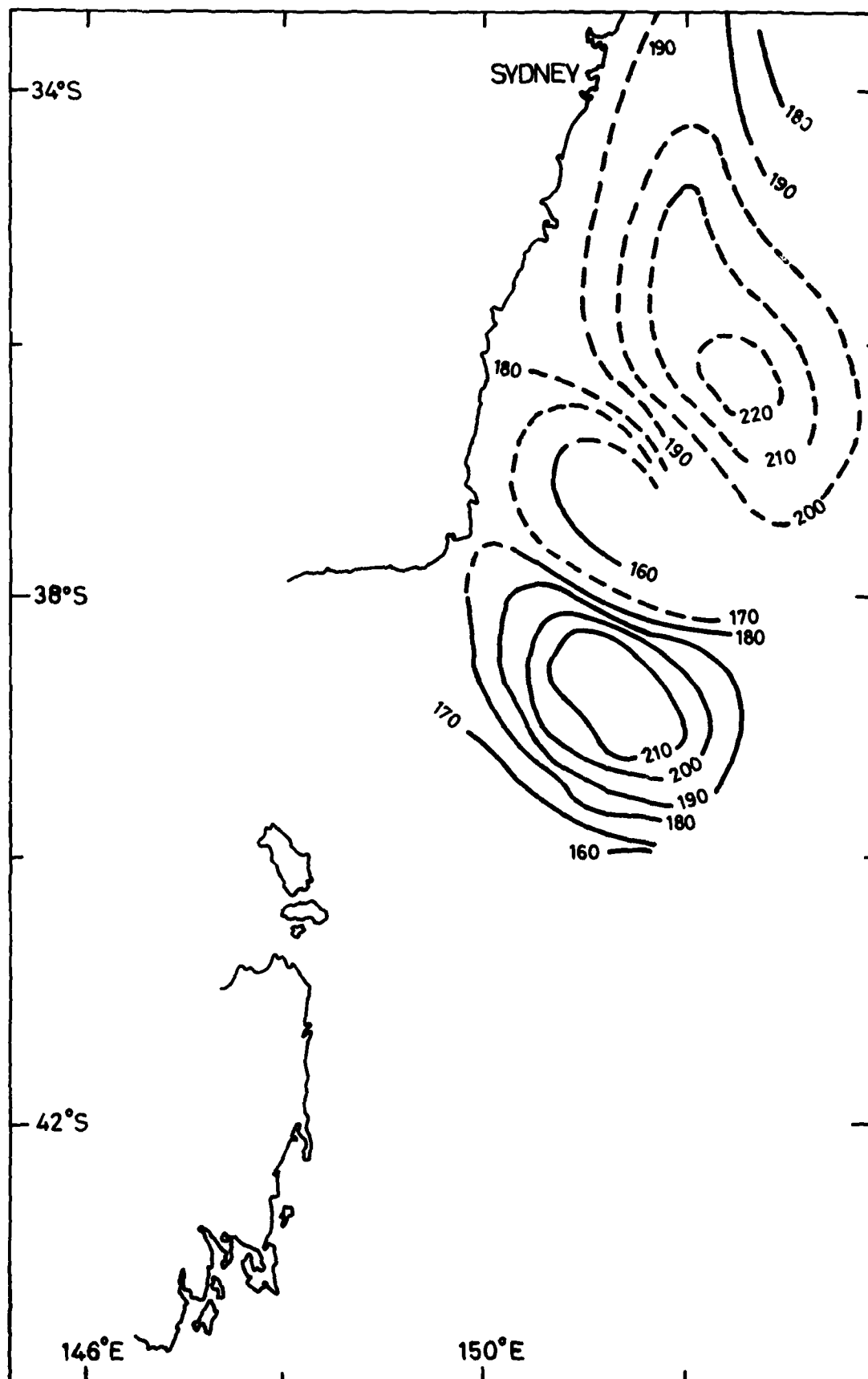


Fig. 29a. Dynamic Height K3/77/2 13-17 March 1977.

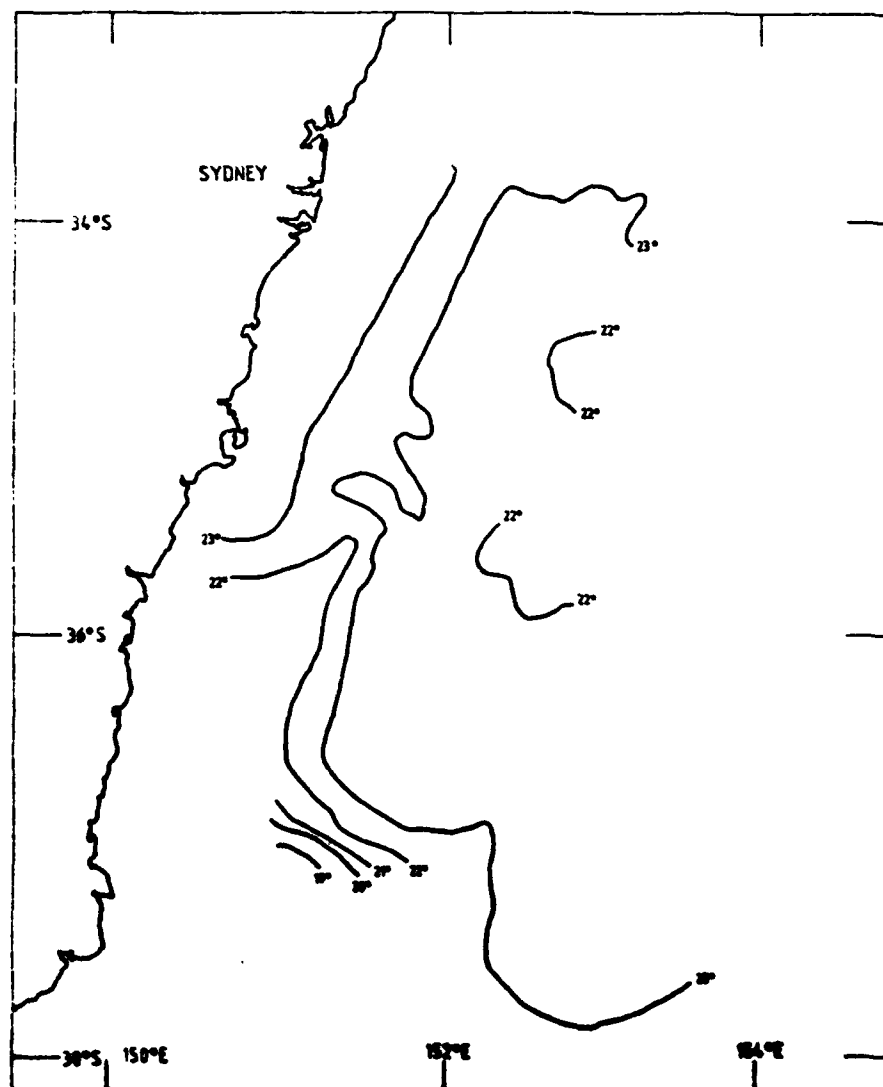


Fig. 30 Sea surface temperature RANRL (6/77) 22-28 March 1977

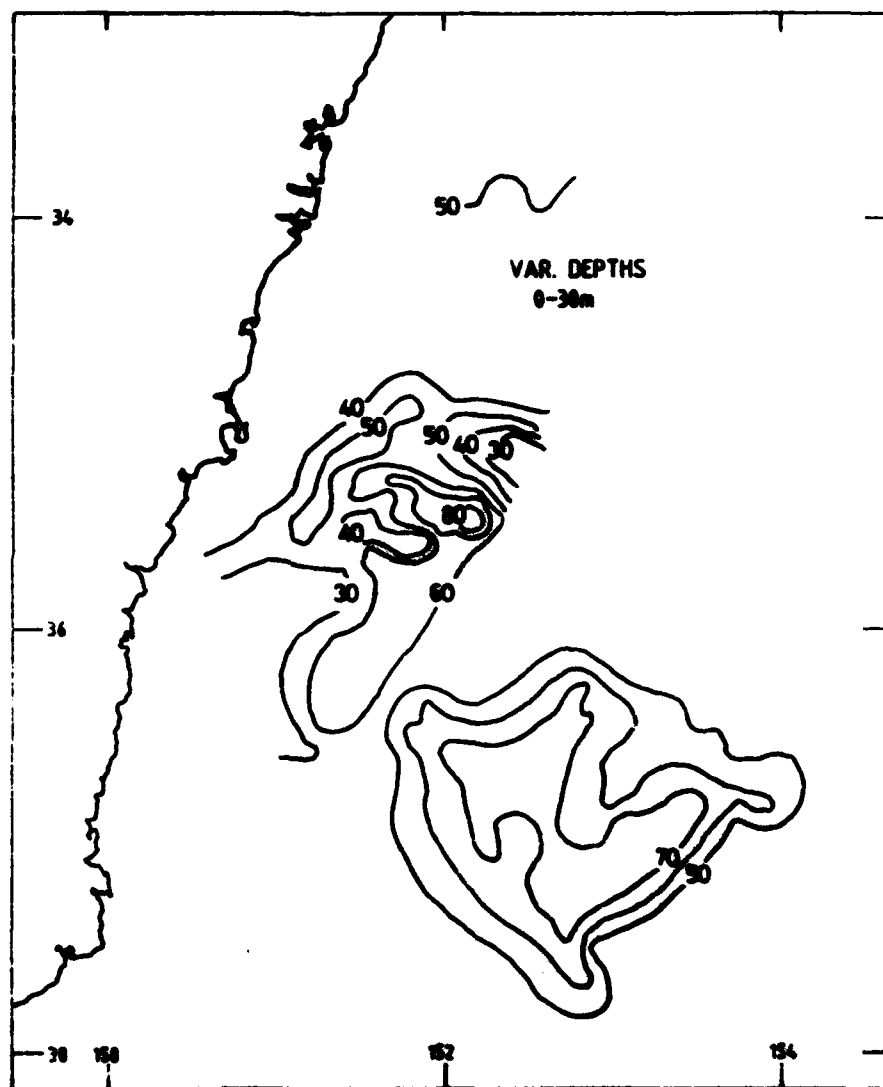


Fig. 31 Mixed layer depth RANRL 6/77 22-20 March 1977.

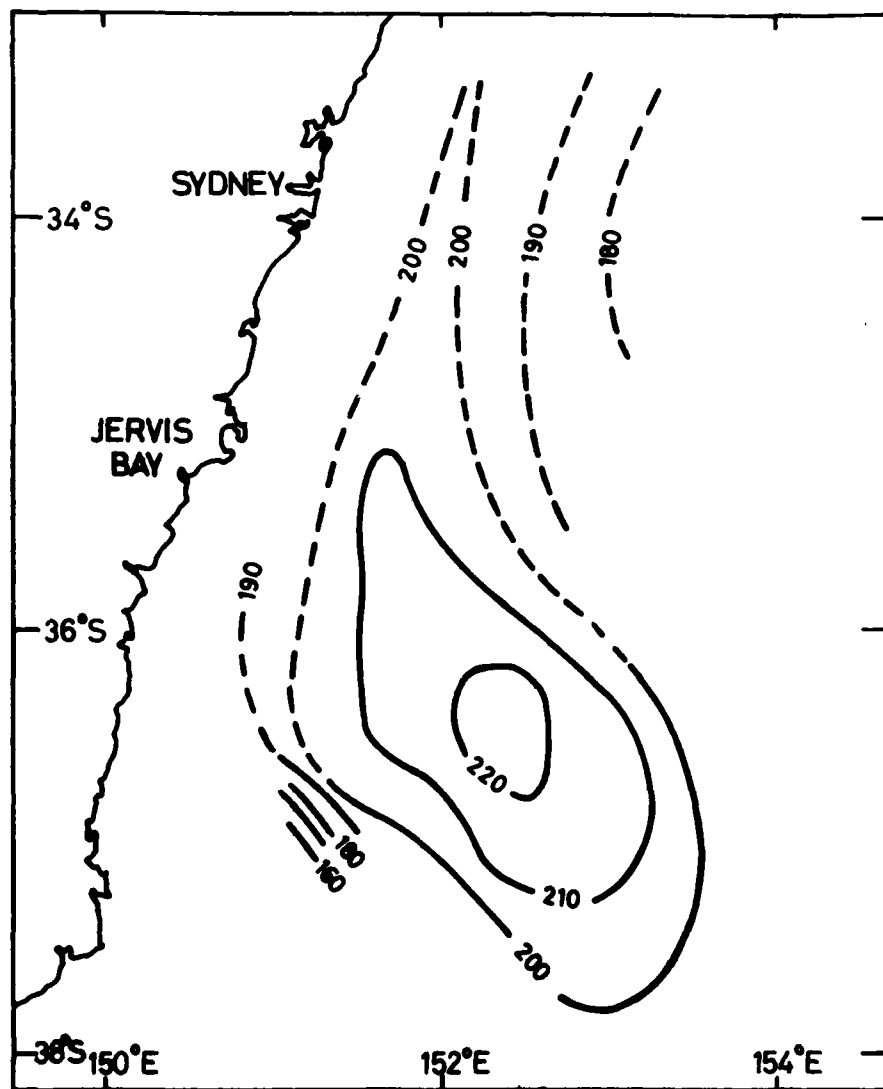


Fig. 31a. Dynamic Height RANRL 6/77
22 - 28 March 1977.

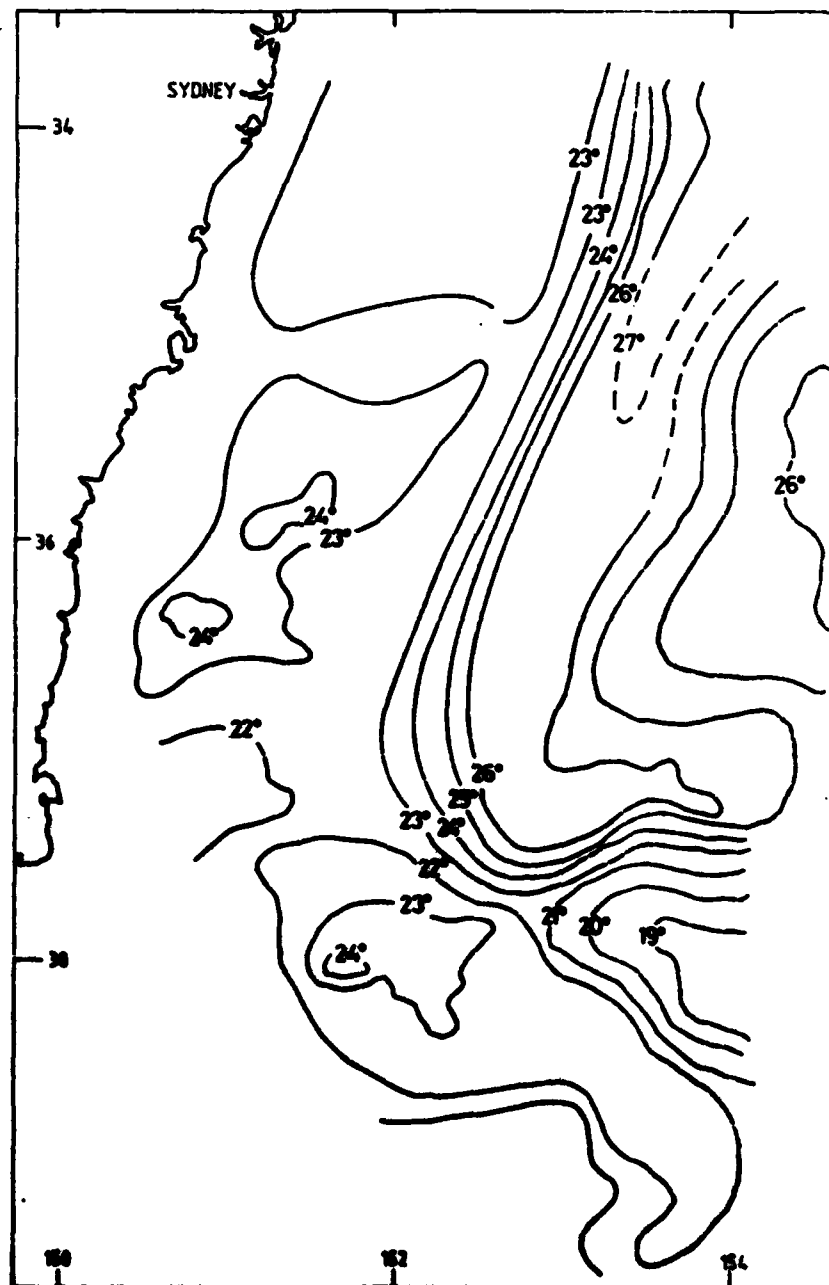


Fig. 32. Sea surface temperature Sprightly 3/78 3-12 Feb. 1978.

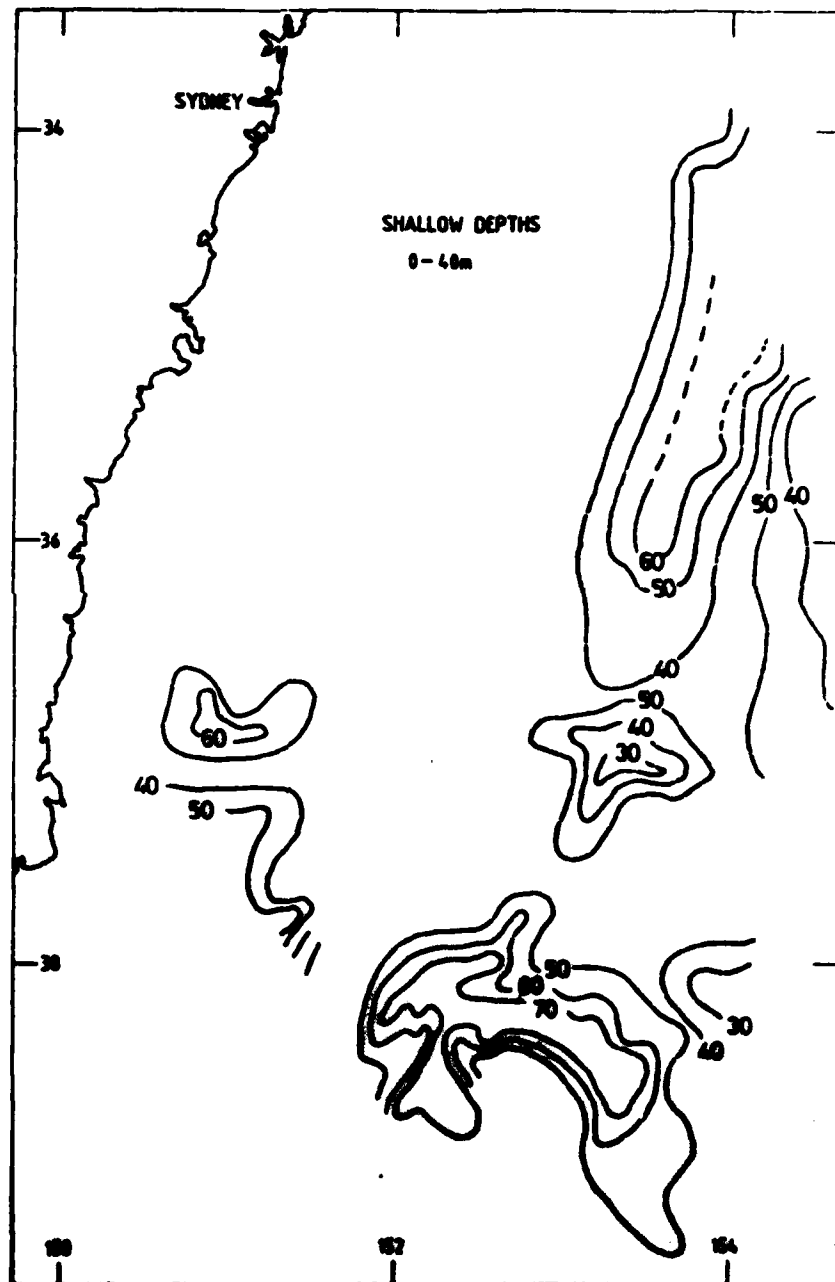


Fig. 33 Mixed layer depths (m) Sprightly 3/78 3-12 Feb. 1978.

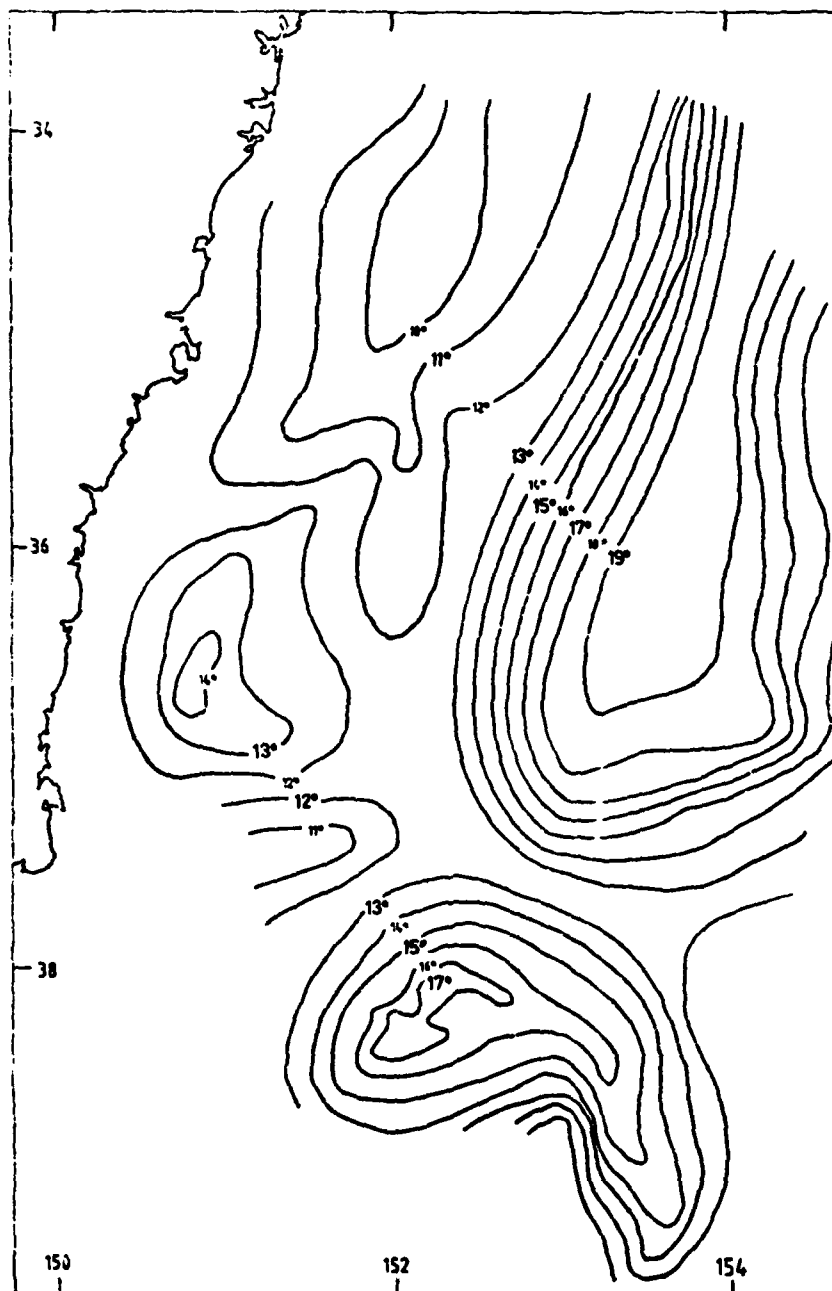


Fig. 34. 250m temperature Sprightly 3/78 3-12 Feb. 1978.

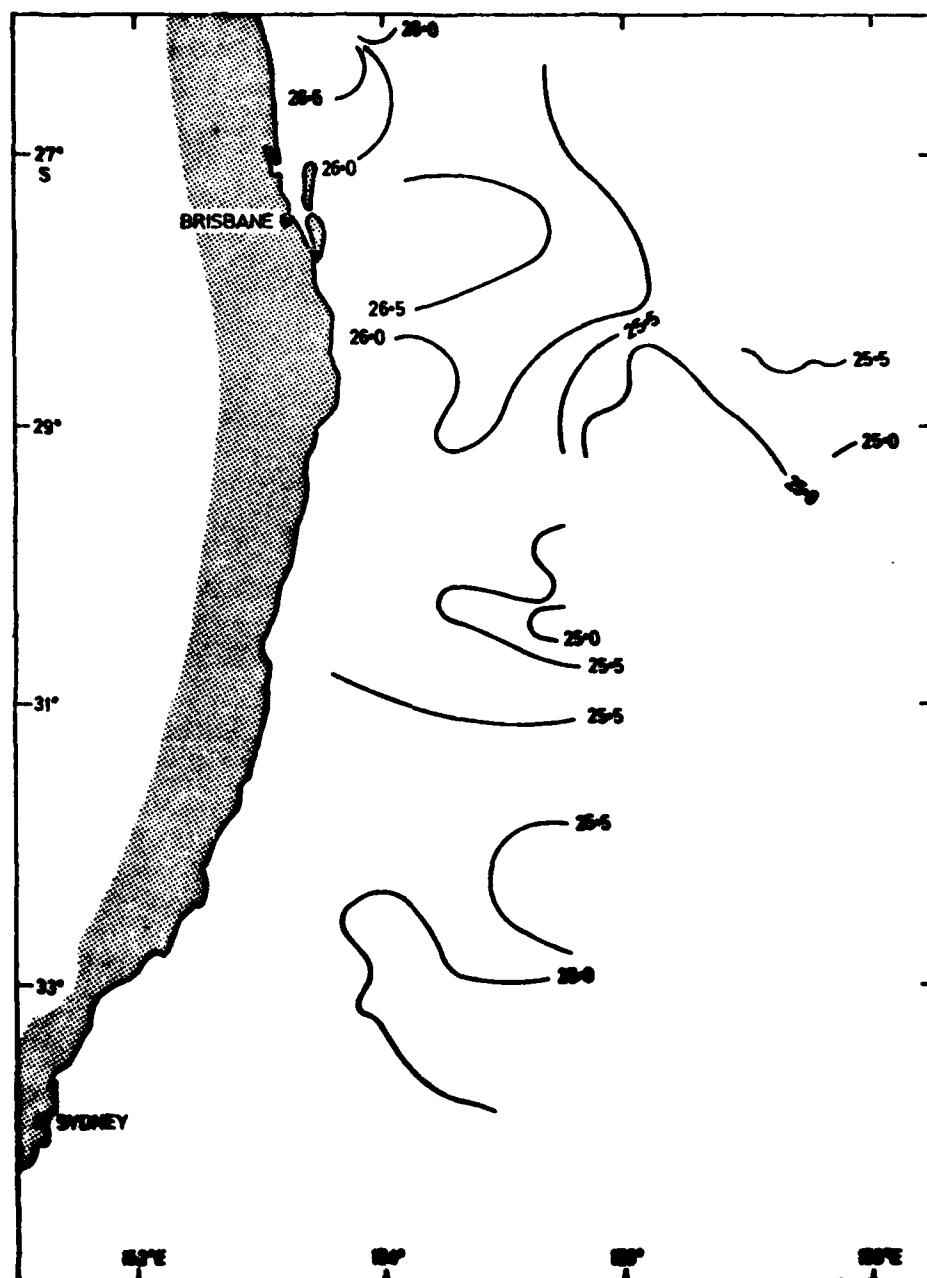


Fig. 35. SST (°C). Cruise SP 4/78. 8-22 March 1978.

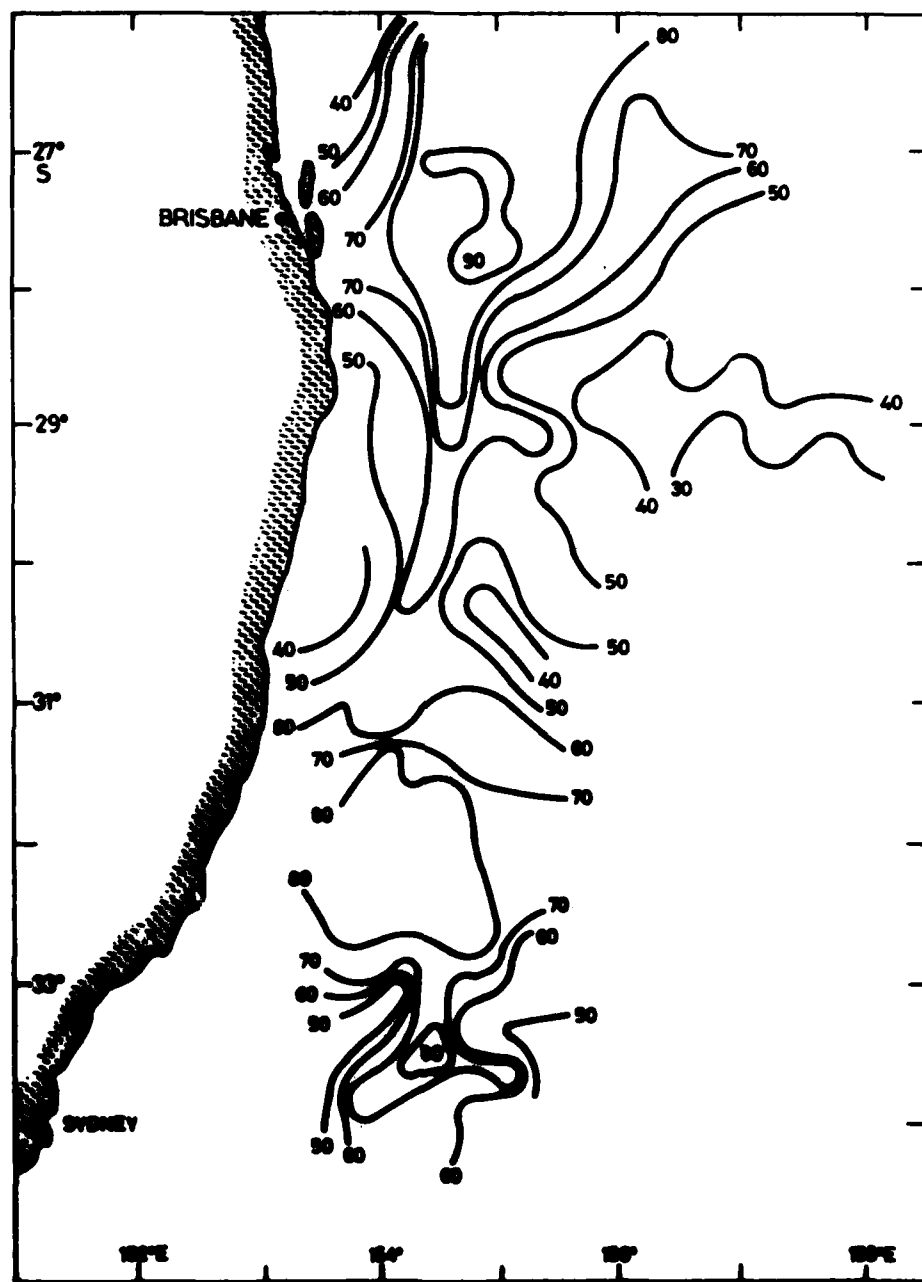


Fig.36. MLD. Cruise SP4/78. 8-22 March 1978.

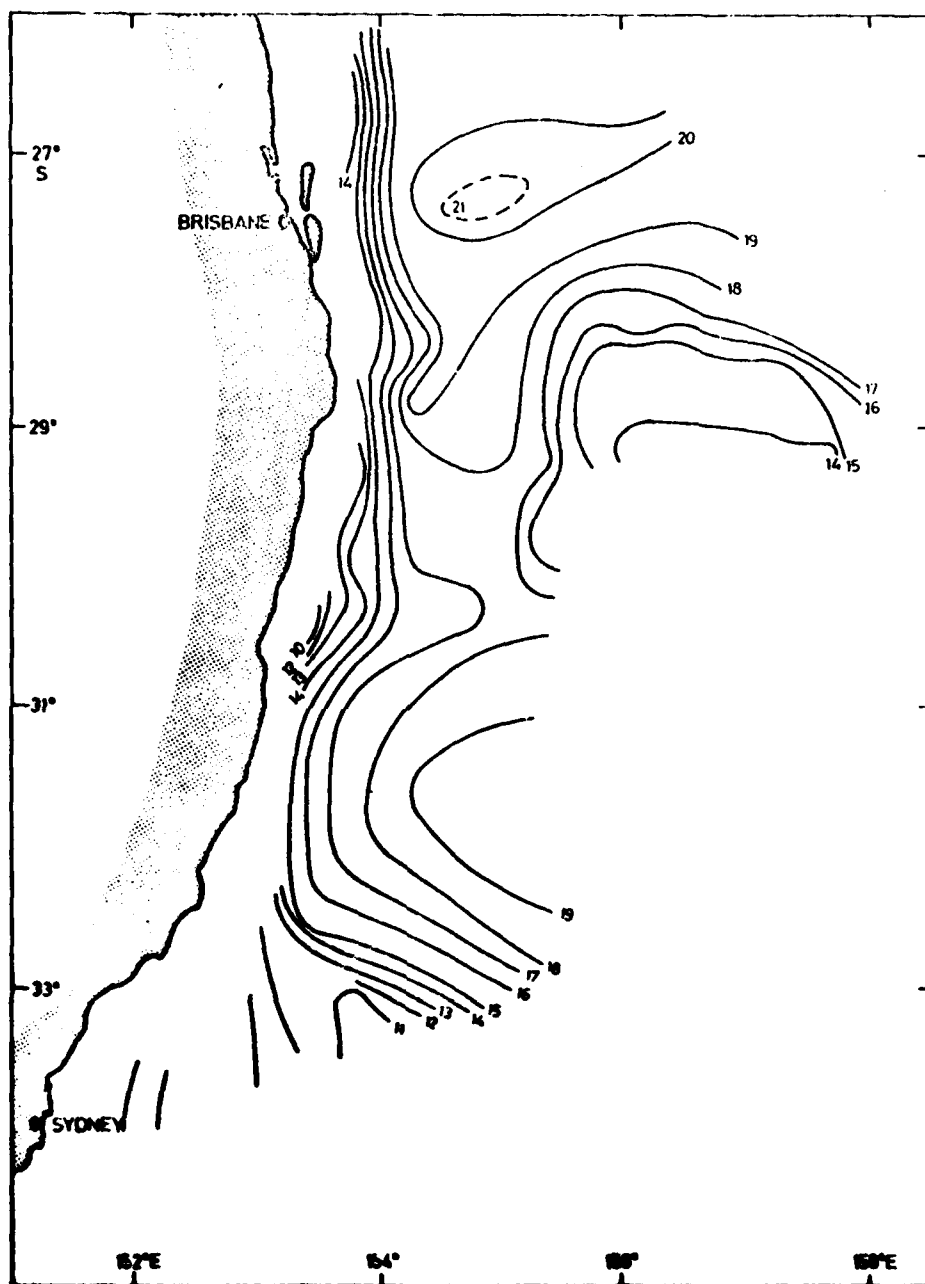


Fig. 37. T_{250} (°C). Cruise SP 4/78.

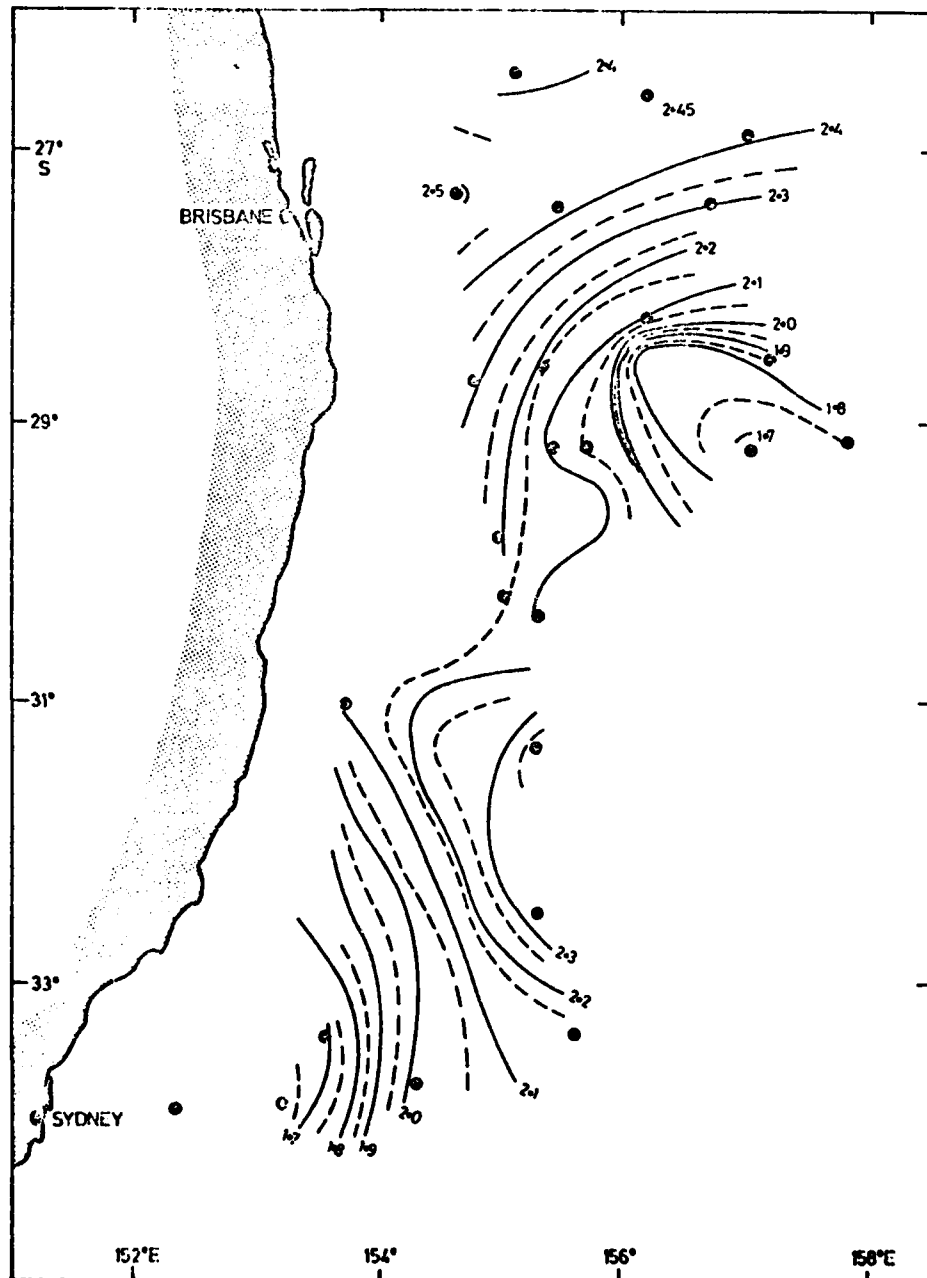


Fig. 38. Dynamic Height relative to 1300 m. Cruise SP 4/78.

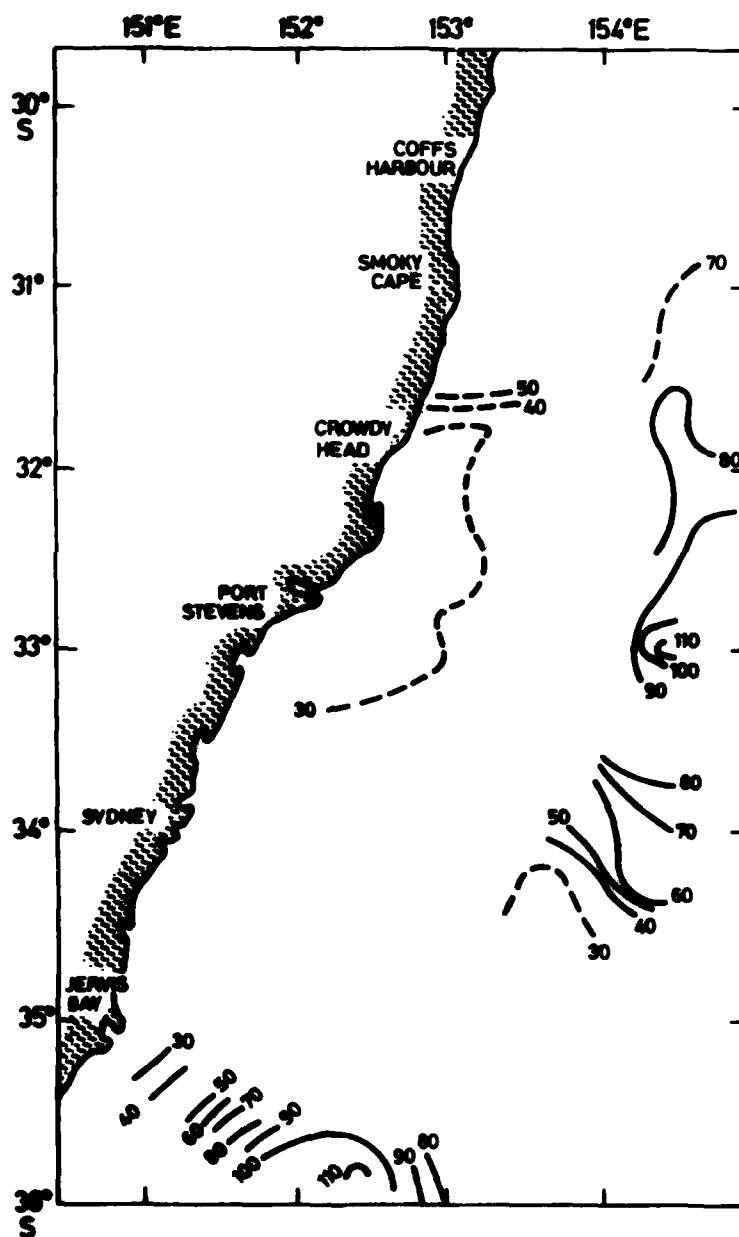


Fig.40. MLD. SP5/78 & SP6/78. Mar.- Apr. 1978.

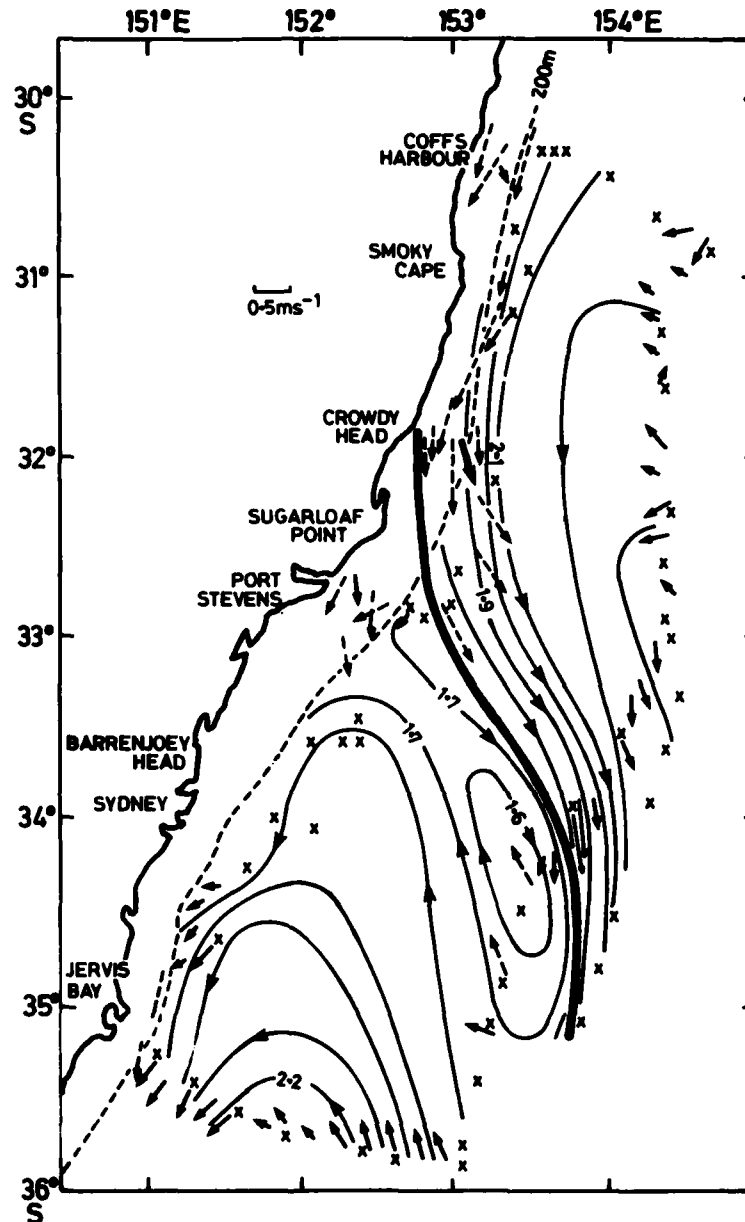


Fig.41. Results of Sprightly cruises Sp5/78 & Sp6/78, 30 Mar. — 11 Apr. 1978. Light full lines are contours of surface dynamic height relative to 1300 db. The heavy full line shows the position of a surface temperature front, from a satellite photo of 11 April. Full arrows are currents measured by GEK, dashed arrows currents measured by ship's drift. The heavy full arrow off Crowdy Head is the 11-day average of a current meter record.

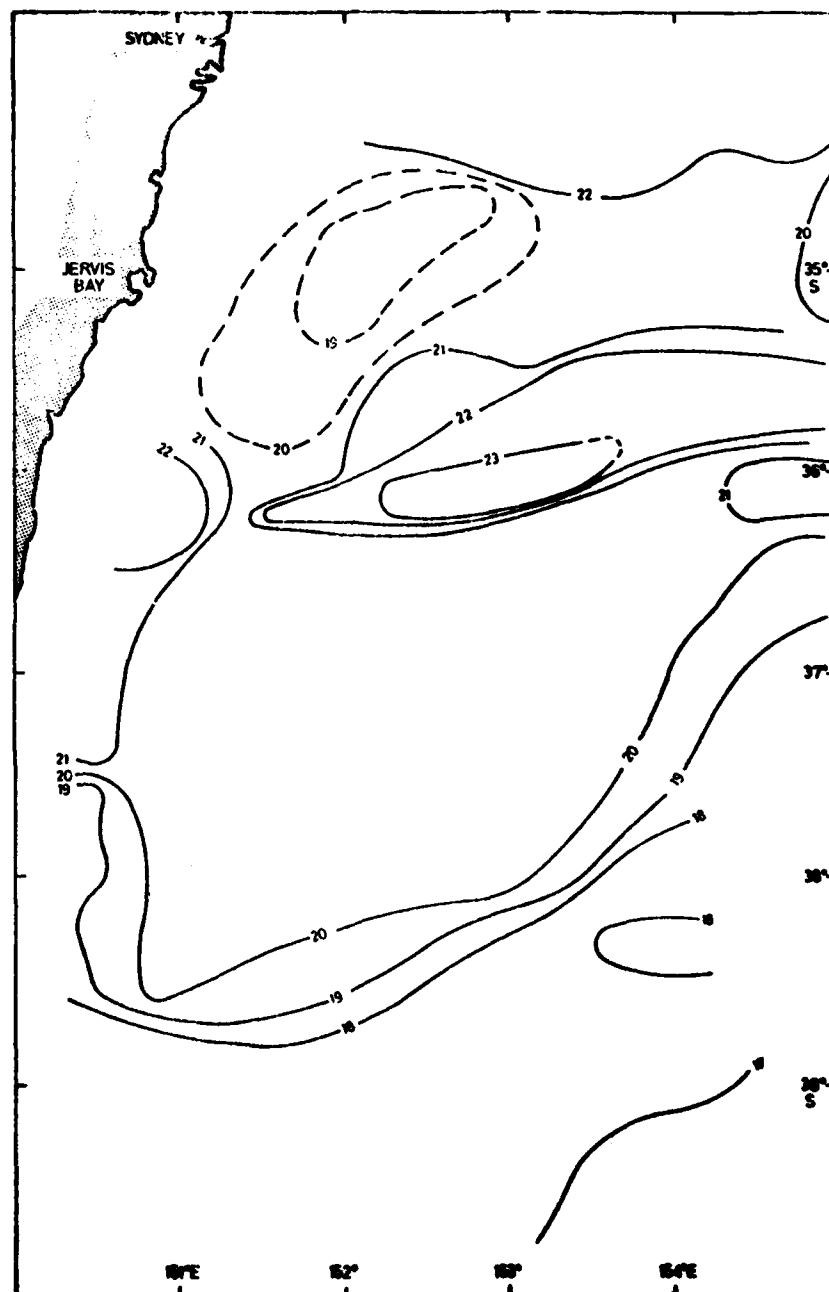


Fig. 42. SST (°C). Cruise SP 6/78. 22 May - 6 June 1978.

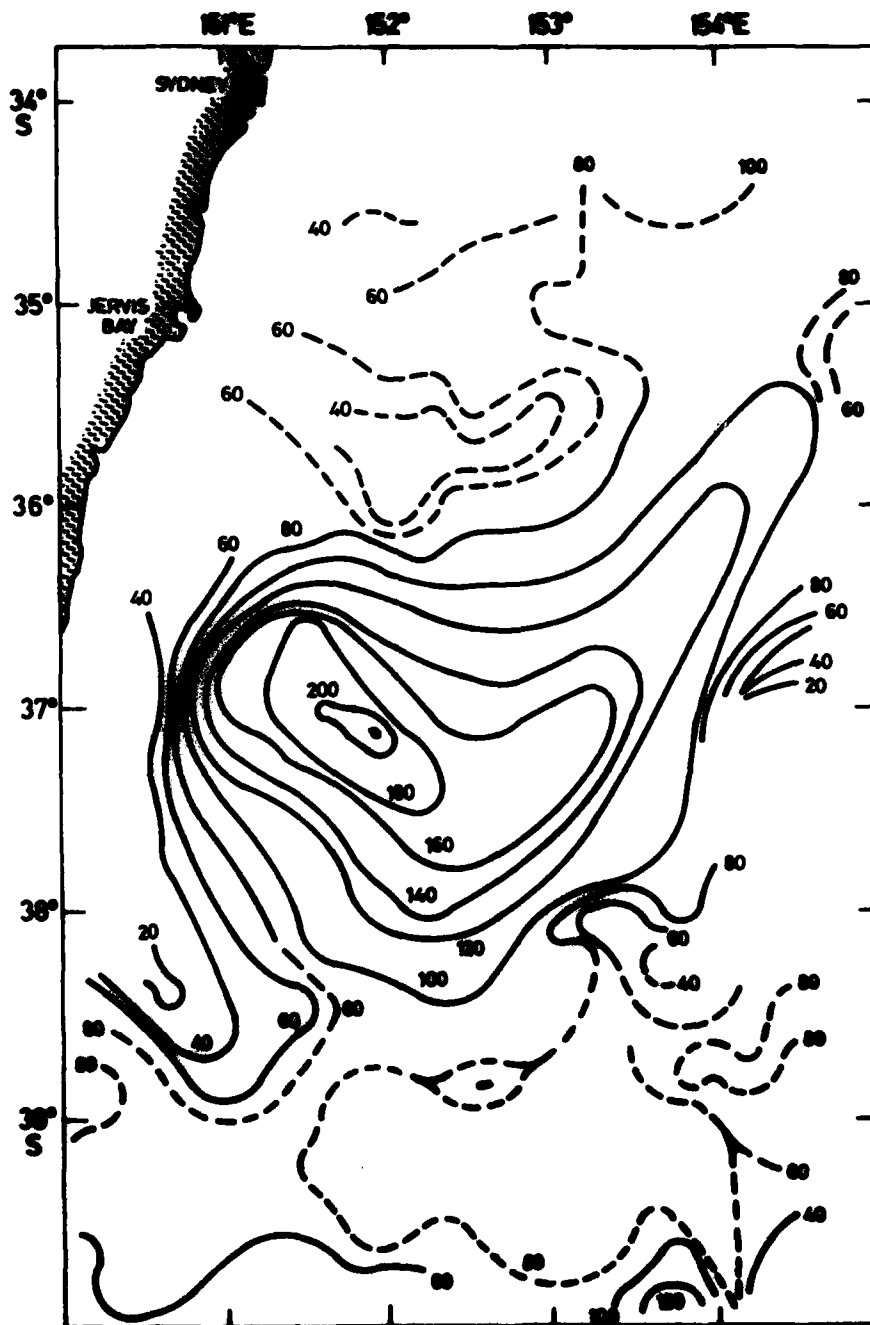


Fig. 43. MLD. Cruise SP8/78. 22 May-6 June 1978.

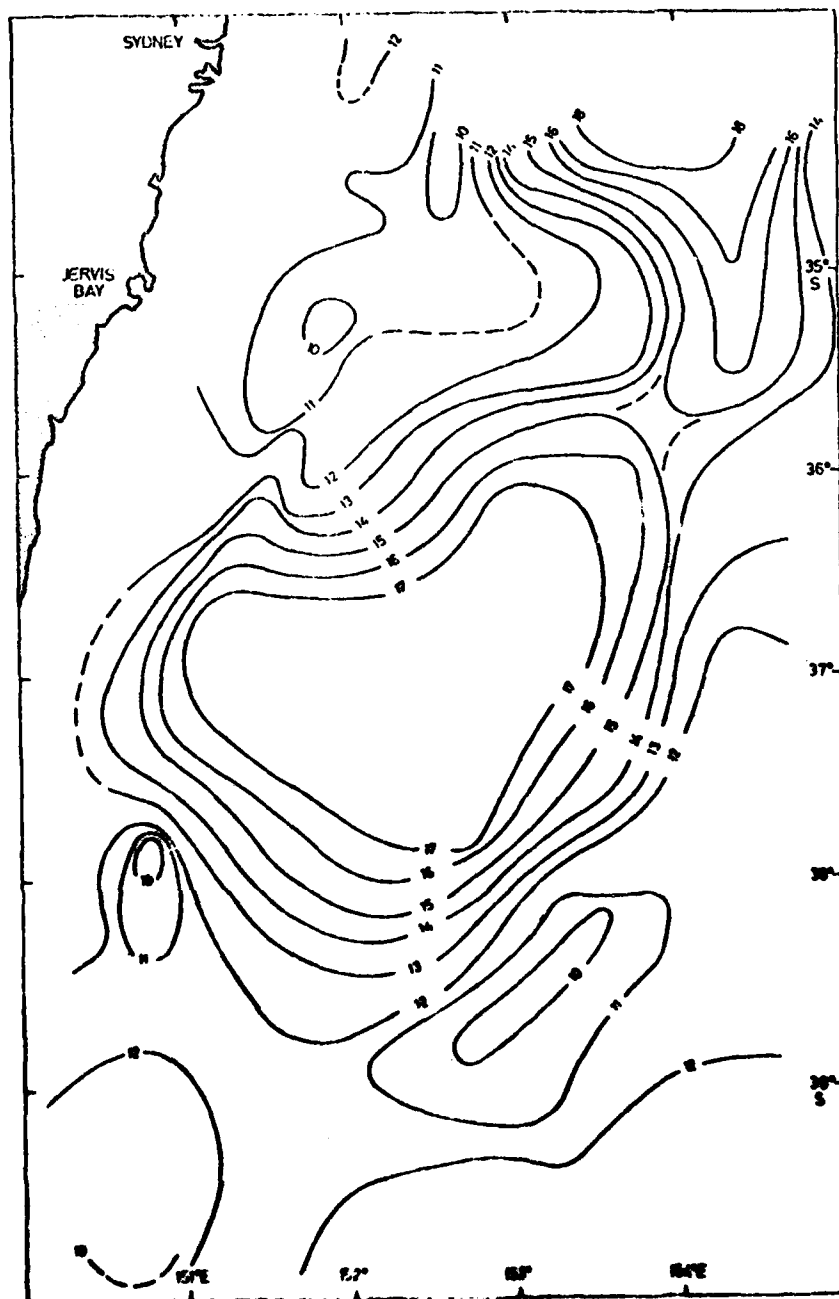


Fig. 44. 1280 PCl. Cruise SP 6/78.

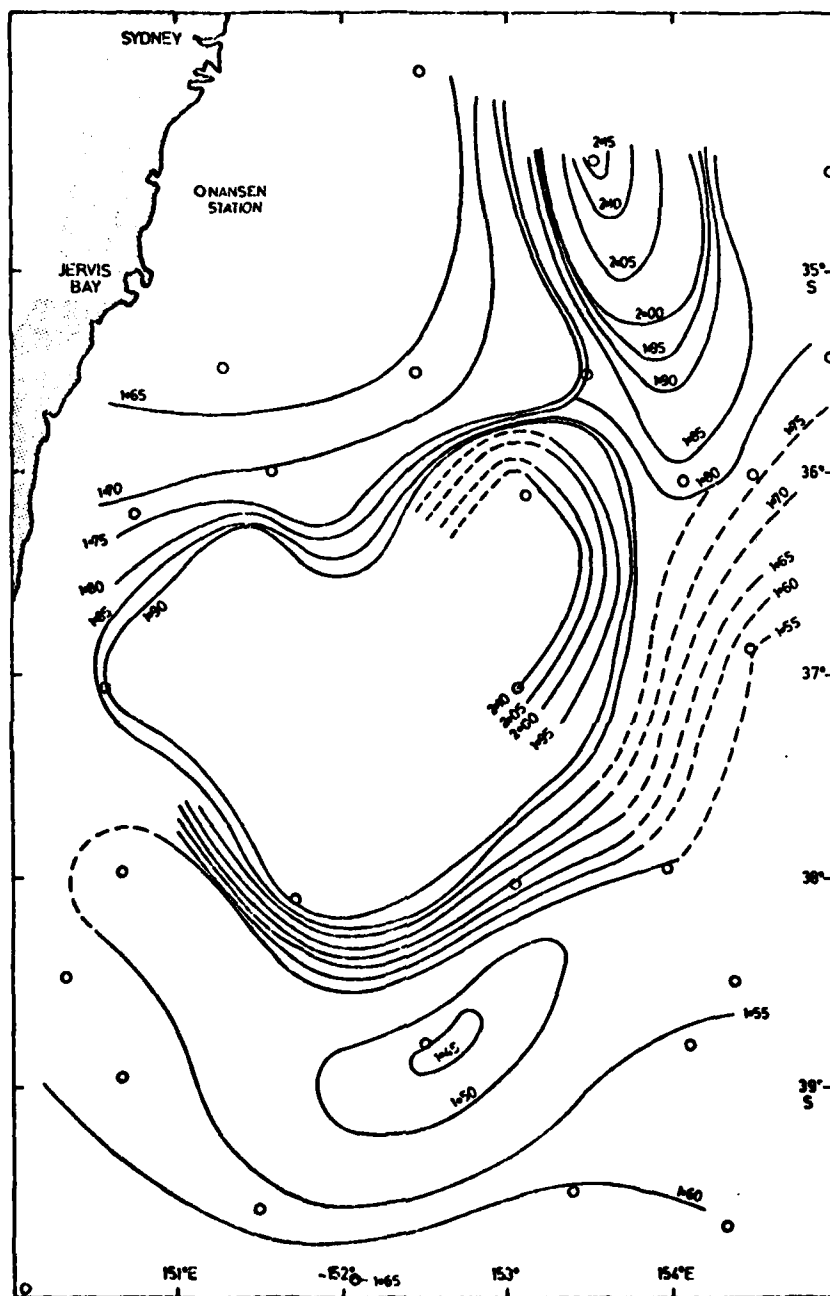


Fig. 45. Dynamic Height relative to 1300m. Cruise SP 8/78.

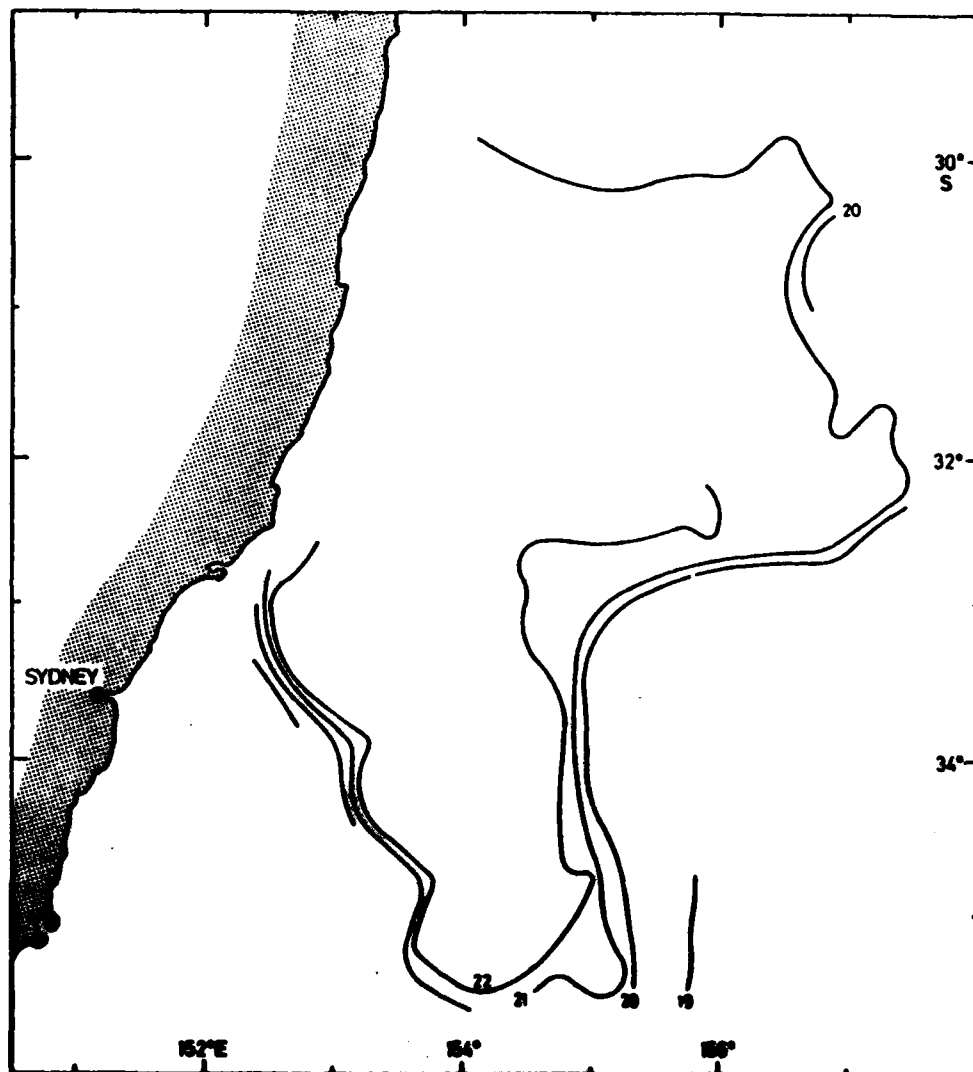
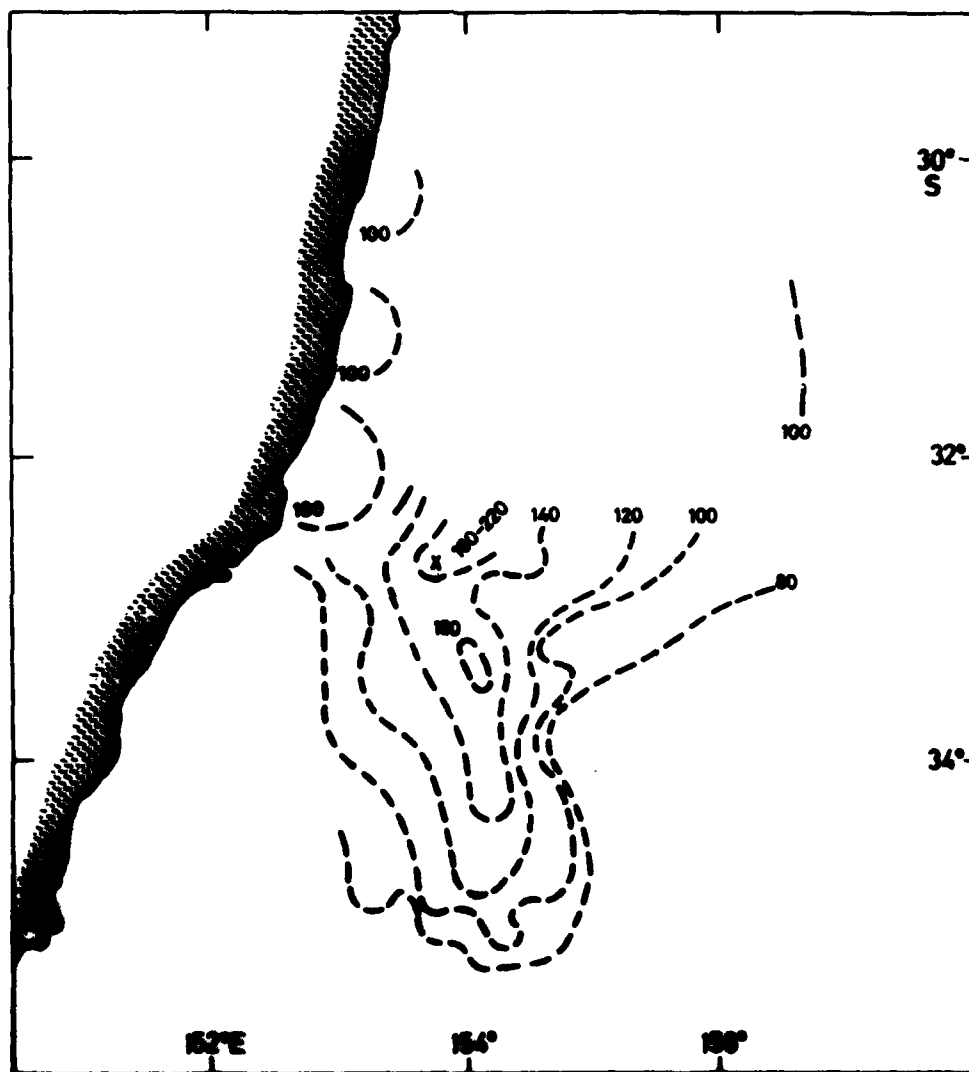


Fig. 46. SST (°C). Cruise SP 9/78. 8-10 June 1978.



**Fig.47. MLD. Cruise SP9/78. 8-19 June 1978.
(Speculative contours).**

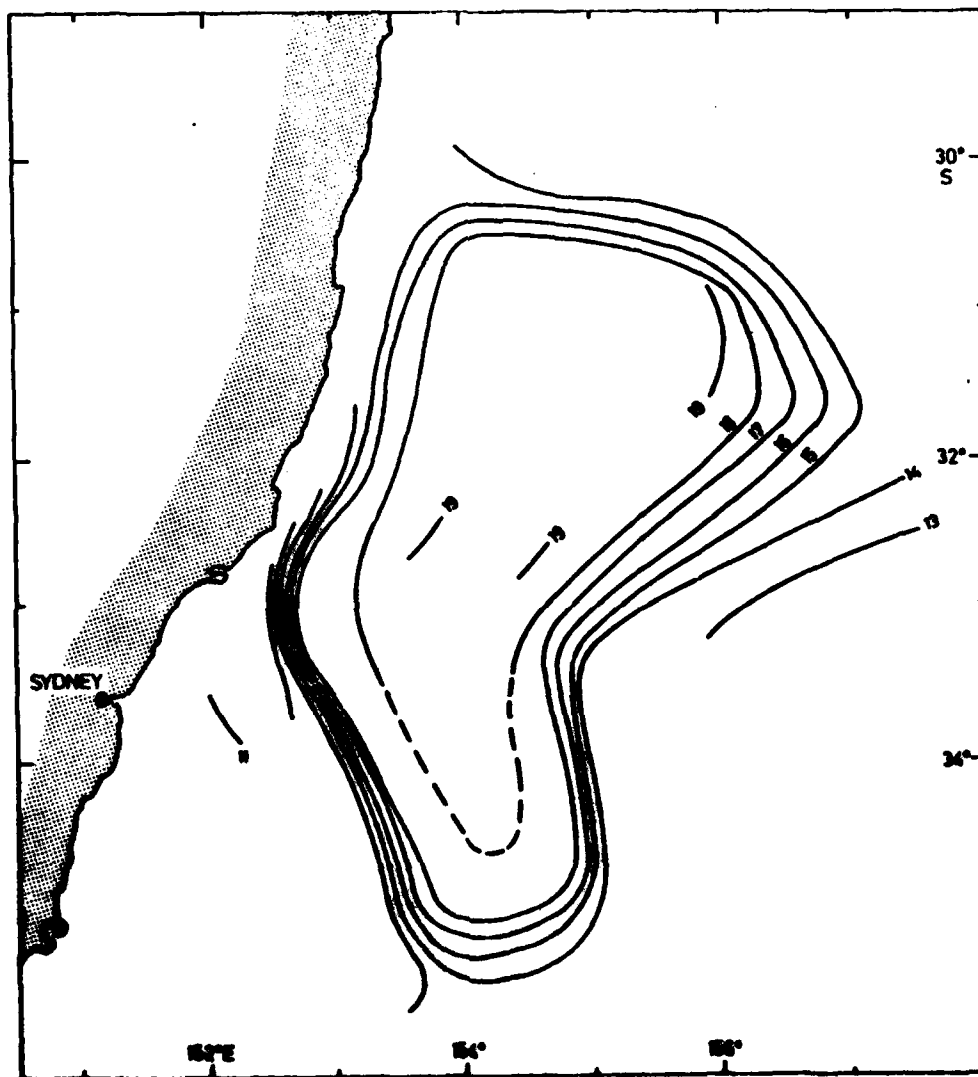


Fig. 48. T₂₅₀ (°C). Cruise SP 9/78.

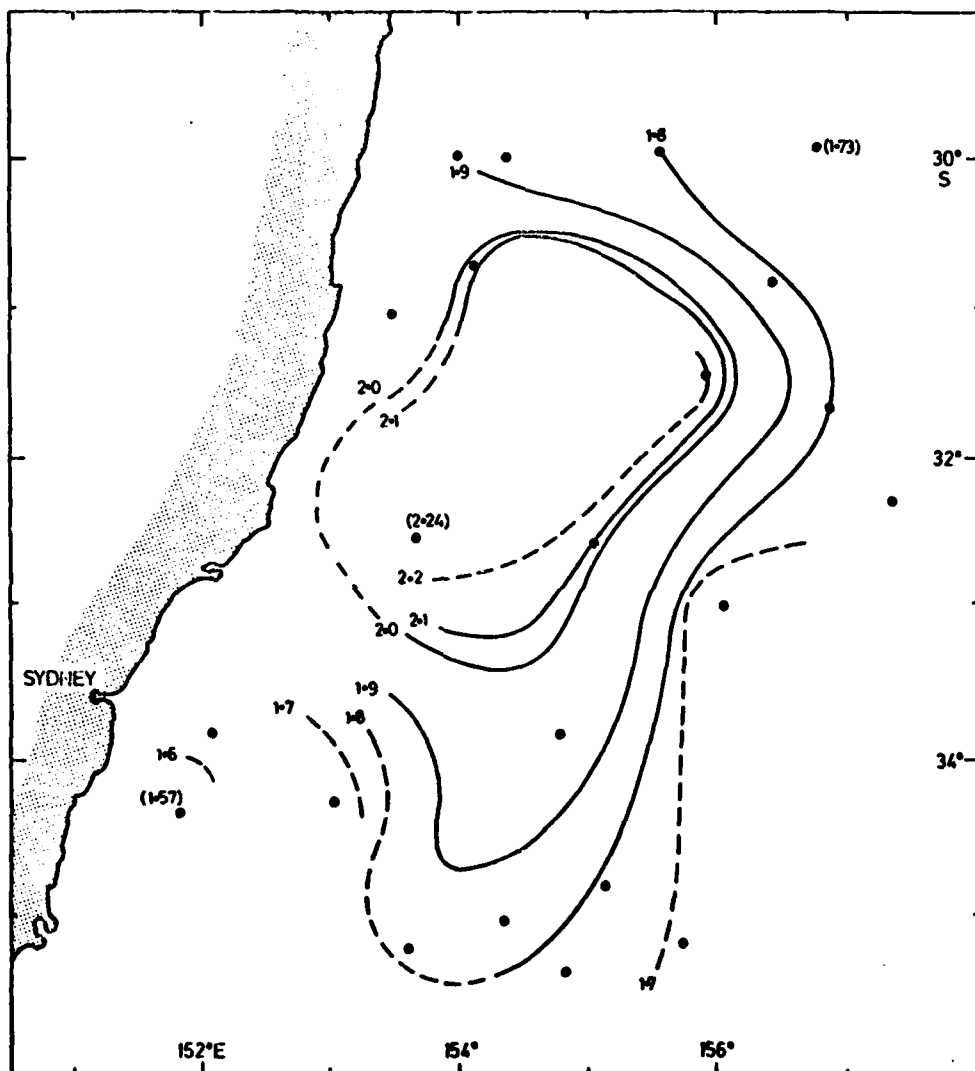


Fig. 49. Dynamic Height relative to 1300 m. Cruise SP 9/78.

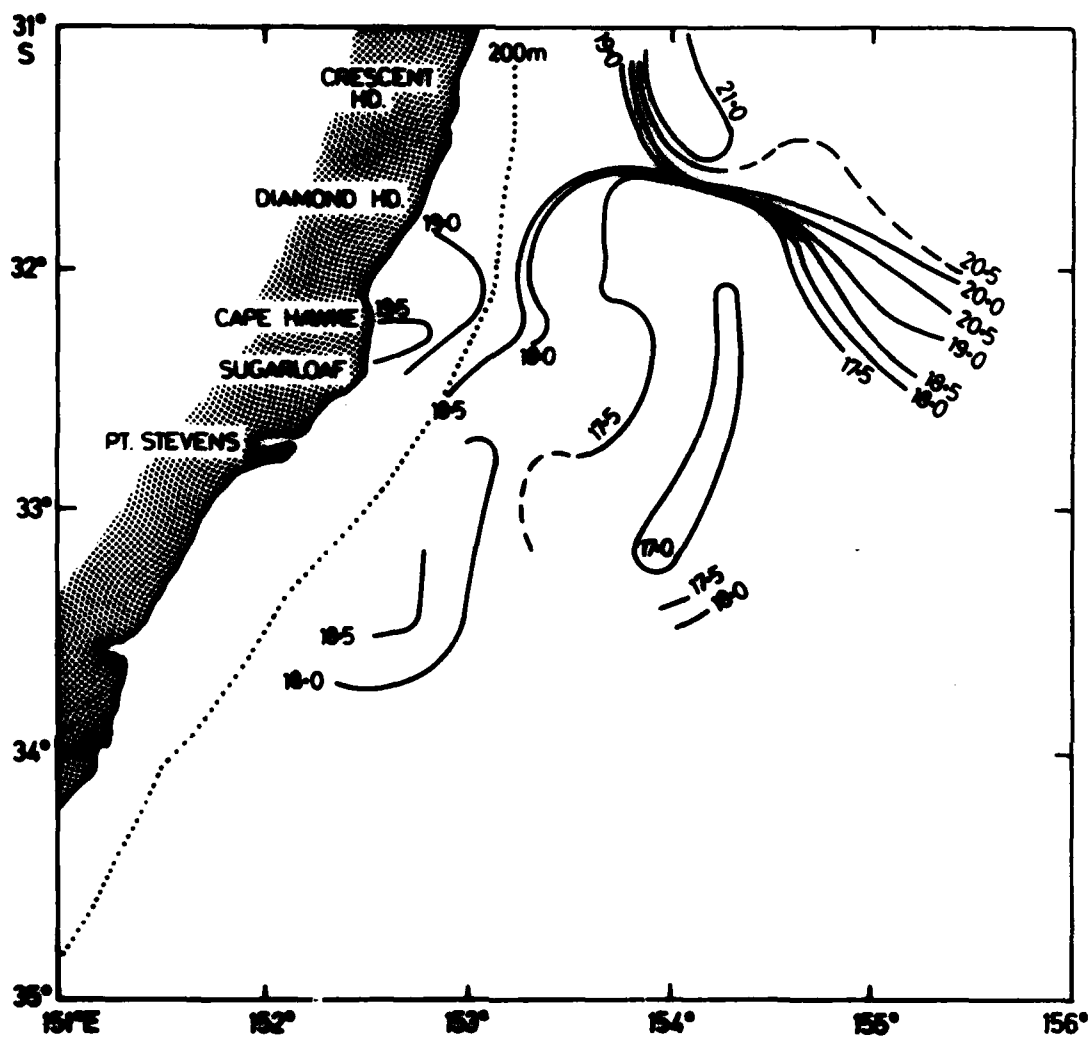


Fig. 50. SST (°C). Cruise SP 10/78. 20 Jul. - 4 Aug. 1978.

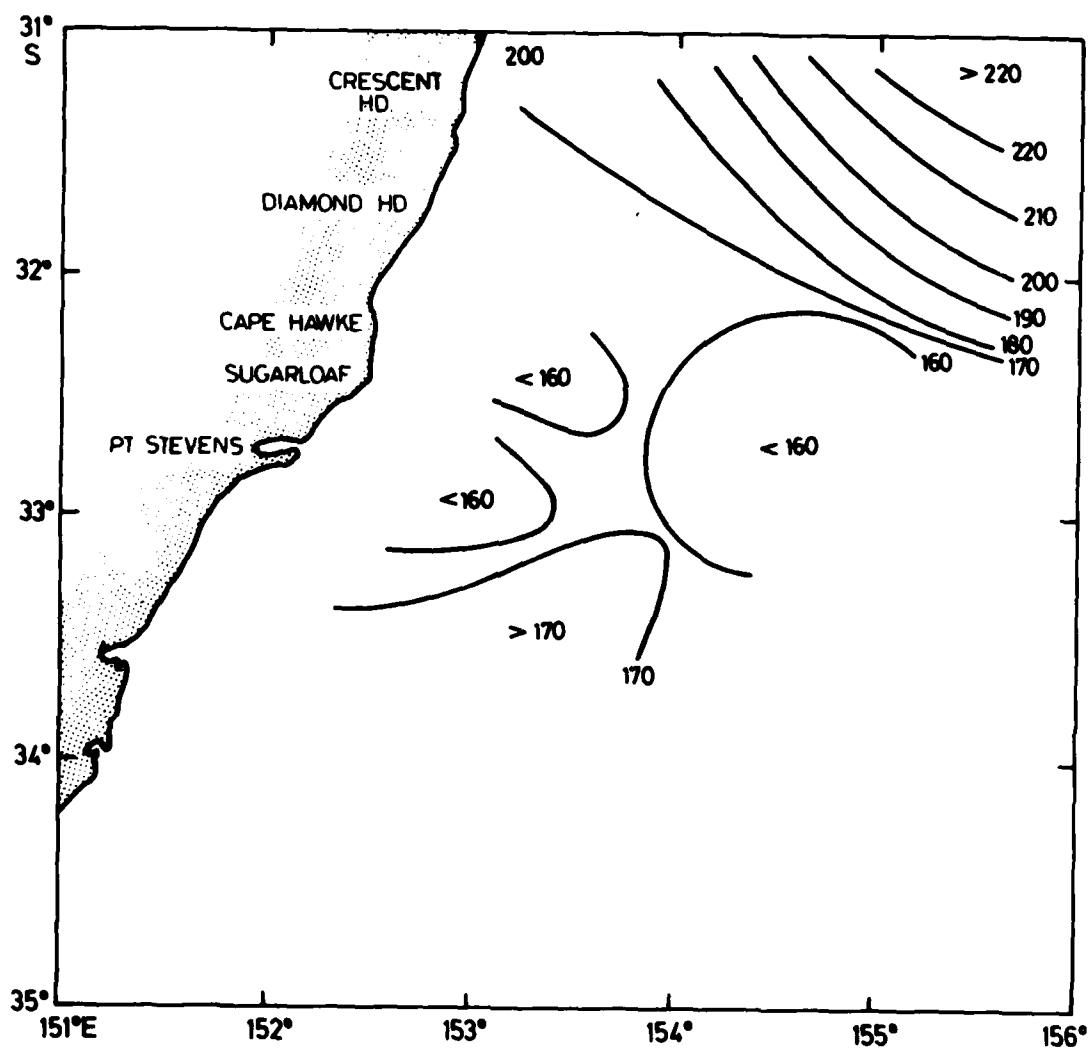


Fig.51. Dynamic Height relative to 1300m. Cruise SP 10/78.

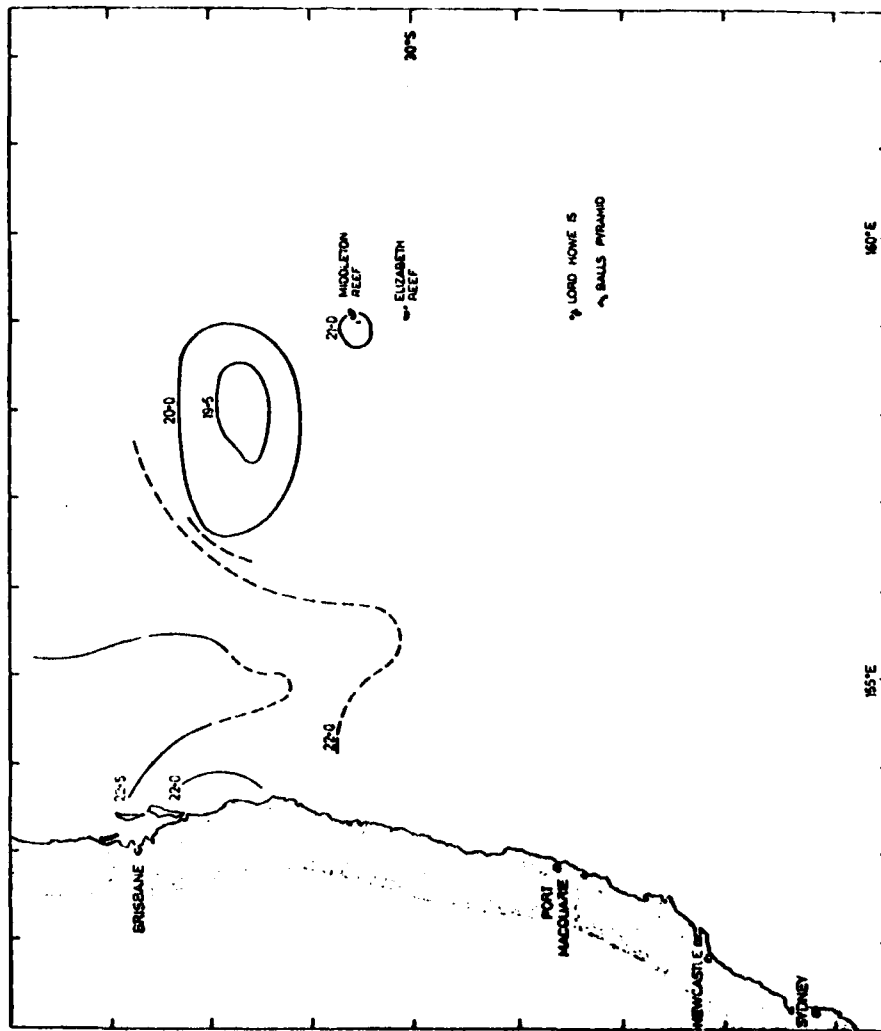


Fig. 52. SST (°C). Cruise SP11/78. 5-18 Aug. 1978.

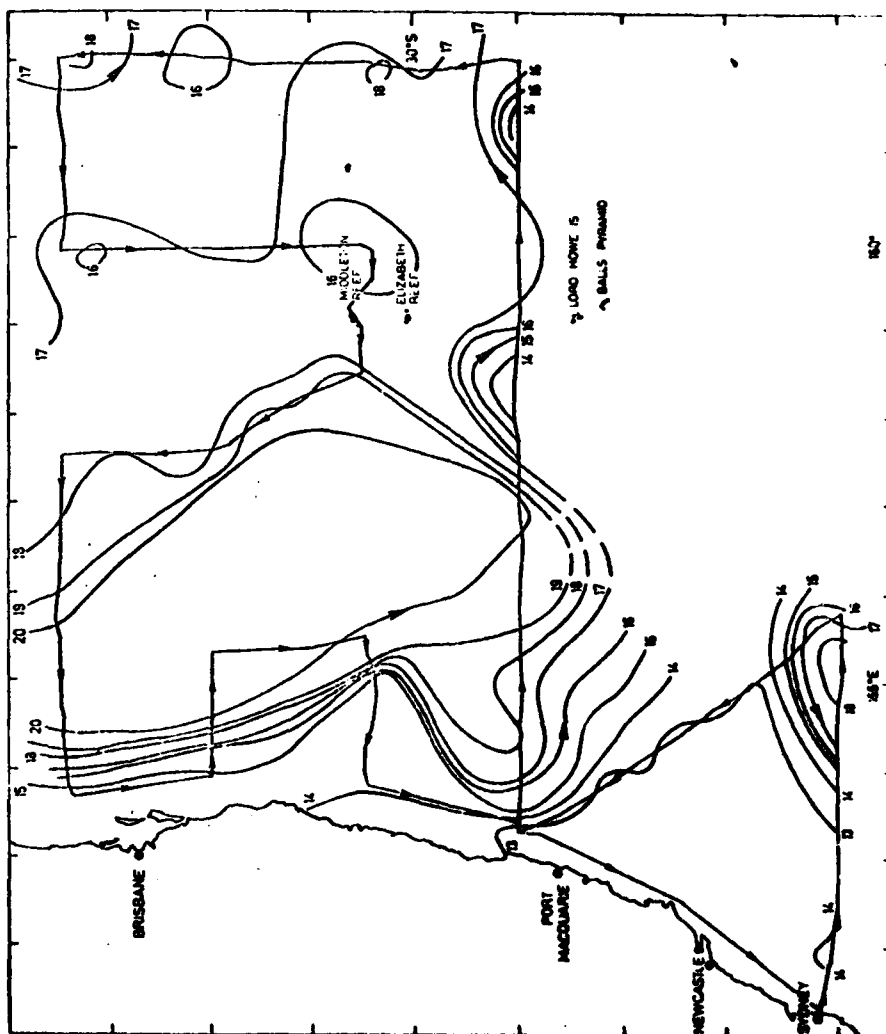


Fig. 53. T. 280. Cruise SP 11/78.

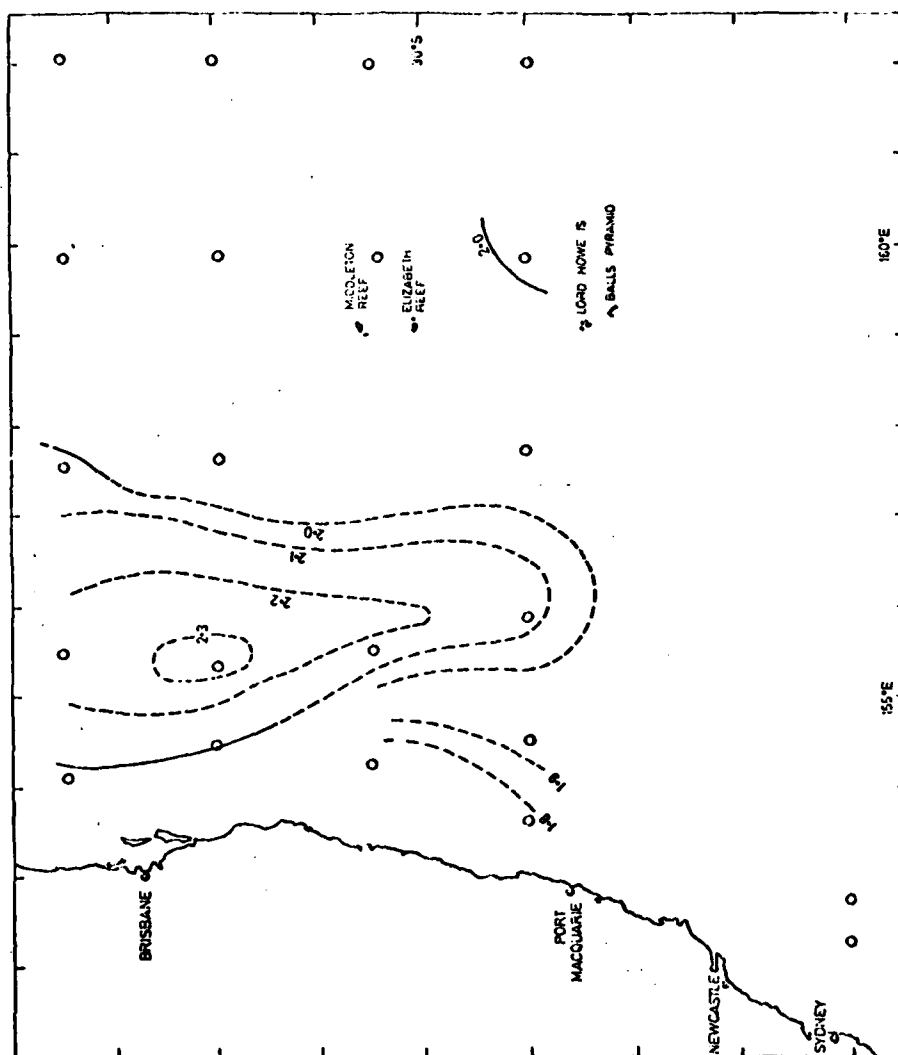


Fig. 54. Dynamic Height relative to 1300m. Cruise SP 11/78.

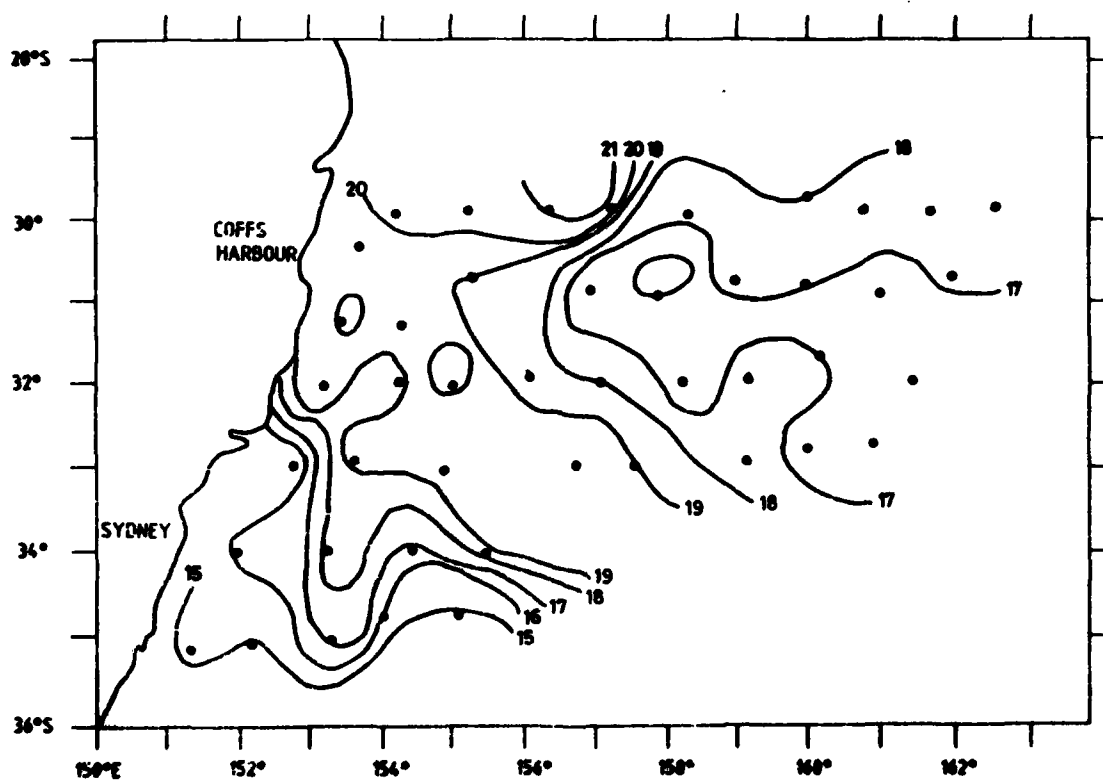


Fig. 55. Sea surface temperature HMAS Diamantina 1-11 Sep. 1978.

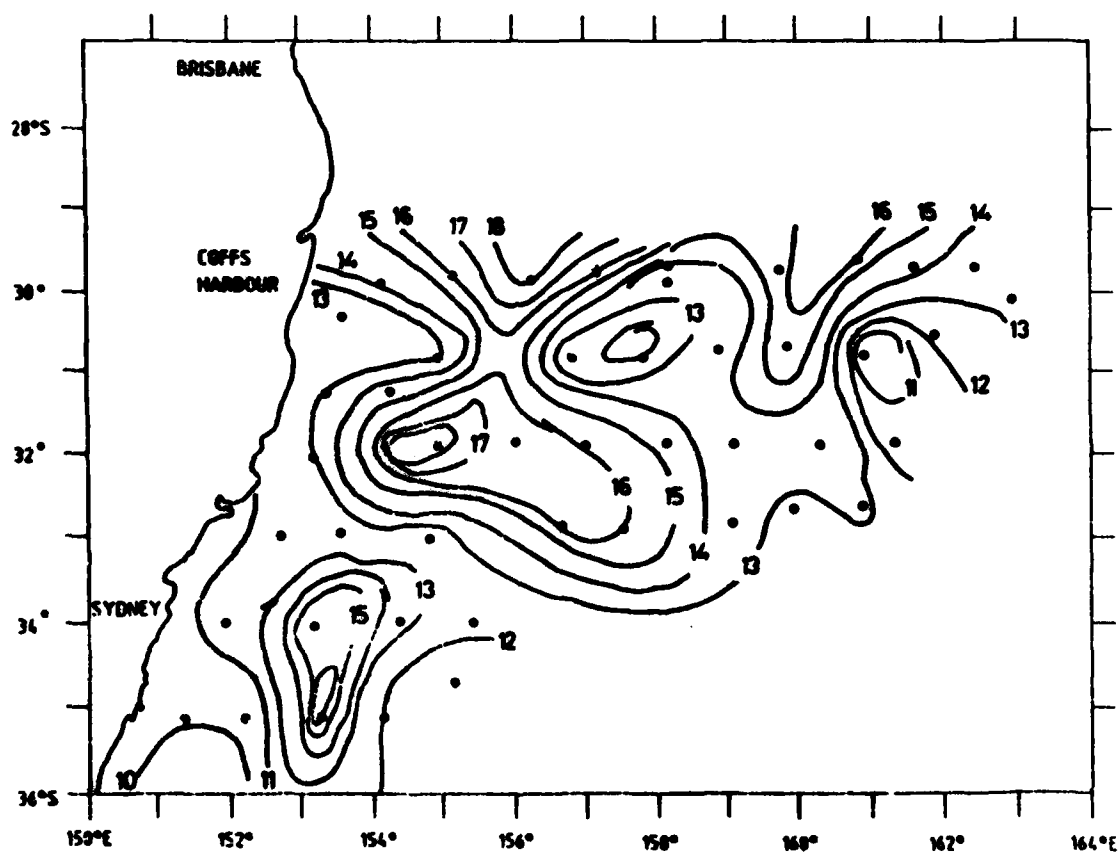


Fig. 56. T250 HMAS Diamantina 4-11 Sep. 1970

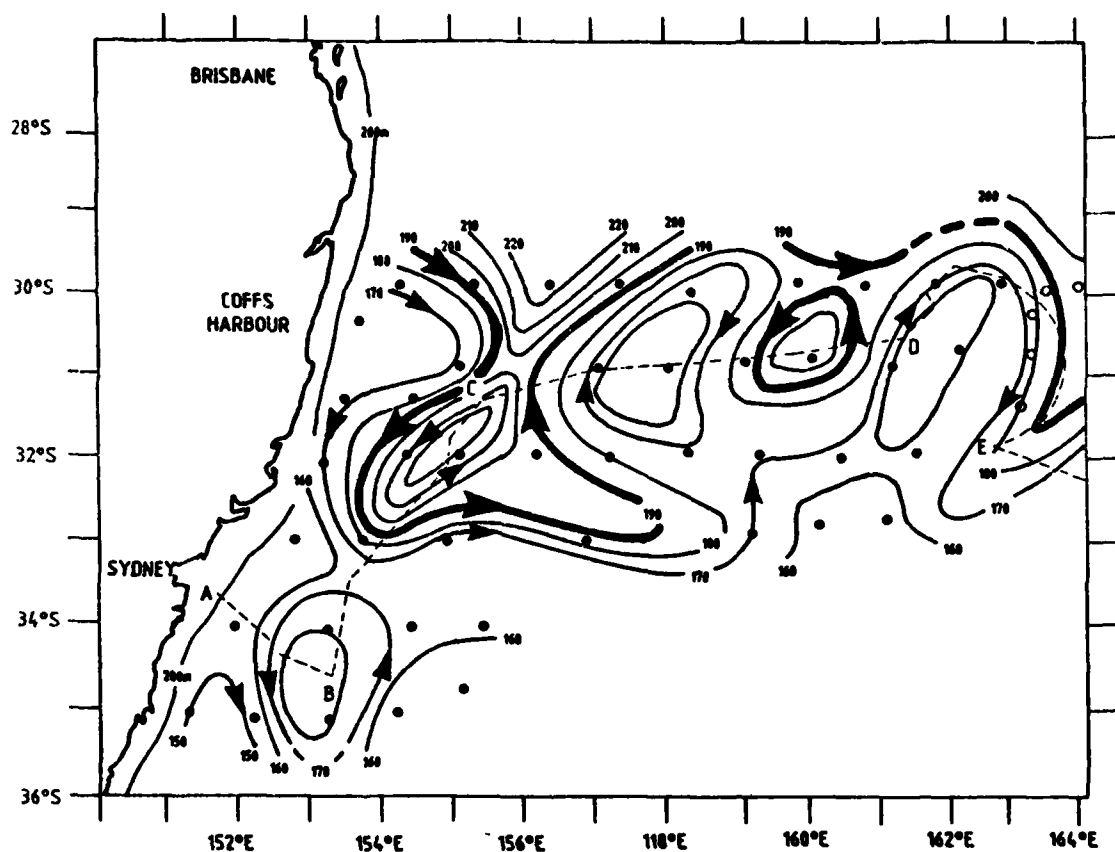
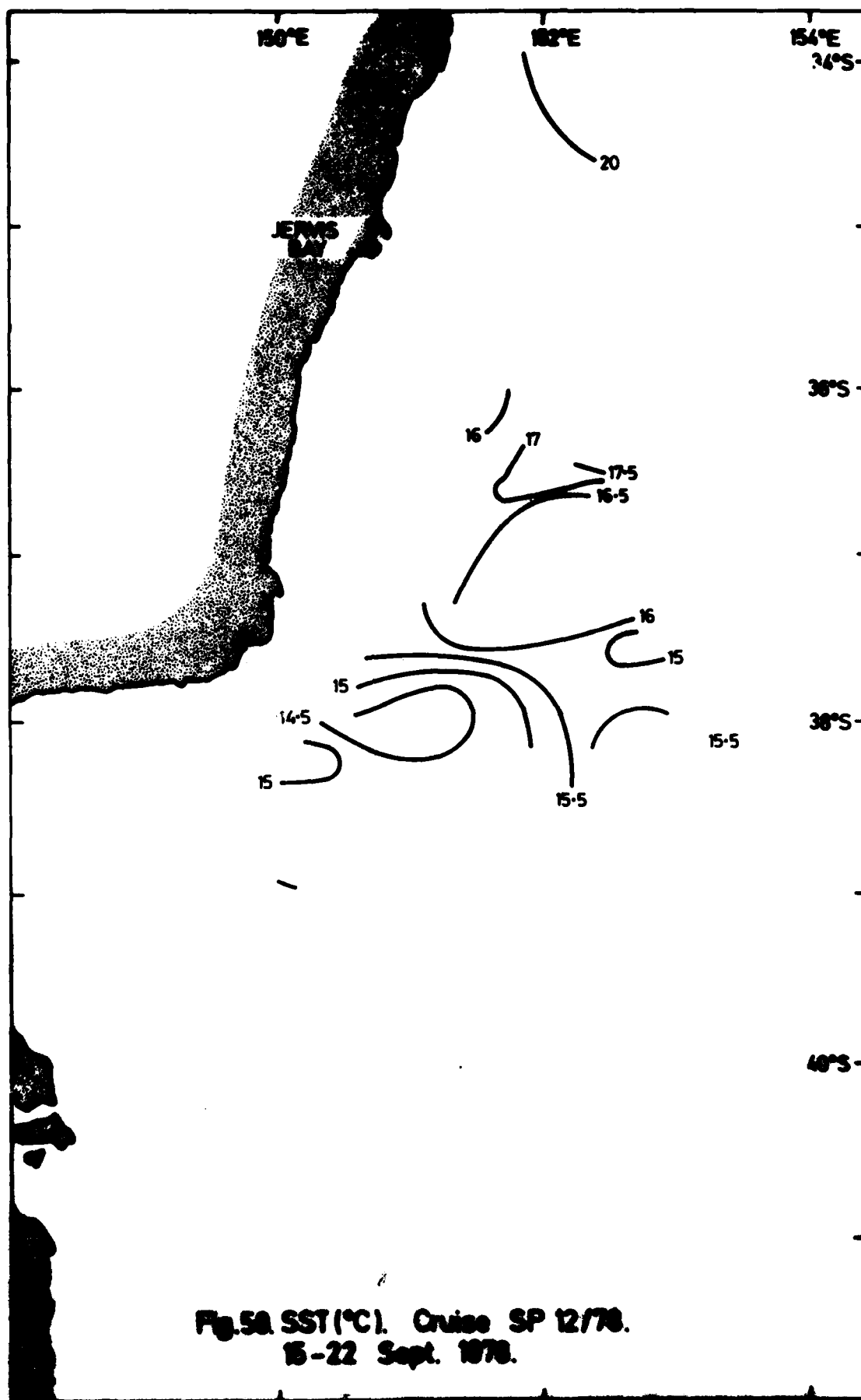


Fig. 57. Dynamic height anomaly (0 re 1300 dbar in dyn cm) from AXBT probes (29 Aug. 1978, filled circles), XBT probes along ABCDEF (HMAS Diamantina, 4-11 Sep. 1978), open circles (HMAS Diamantina, 13-18 Sep. 1978).



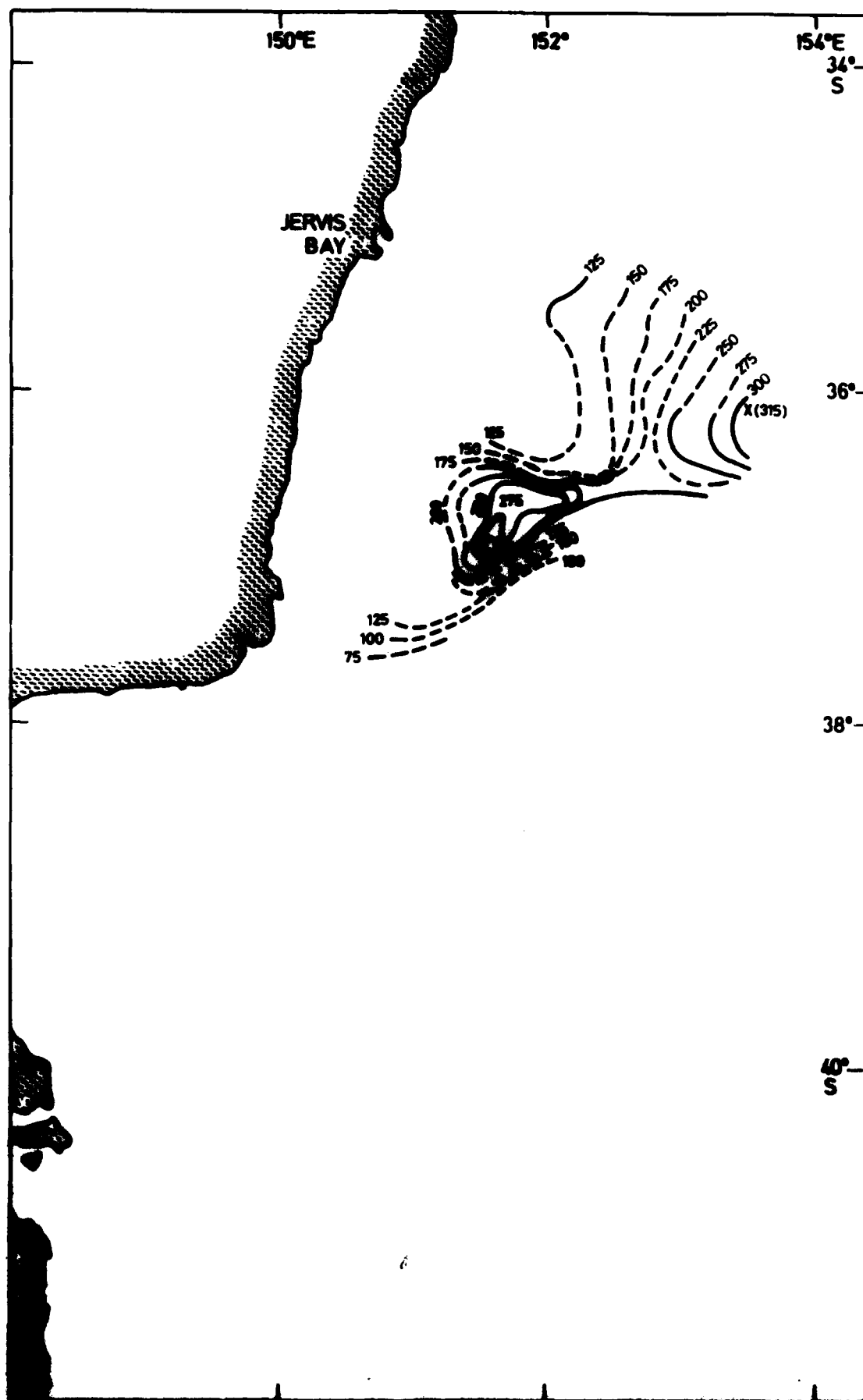


Fig. 2000.0. Cruise SP 12/73. 15-25 Sept. 1973.

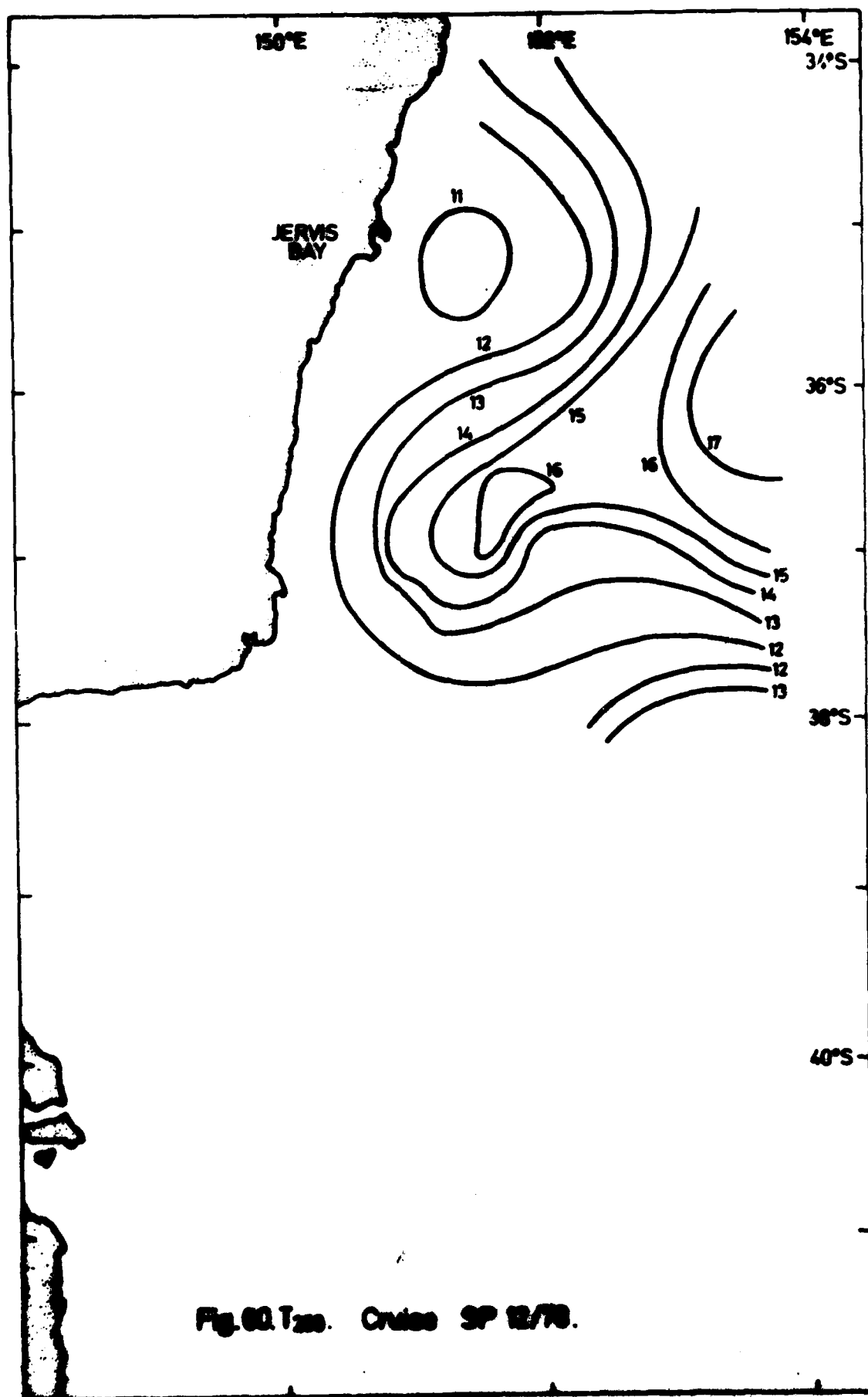


Fig. 60. T₂₀₀. Cruise SP 12/78.

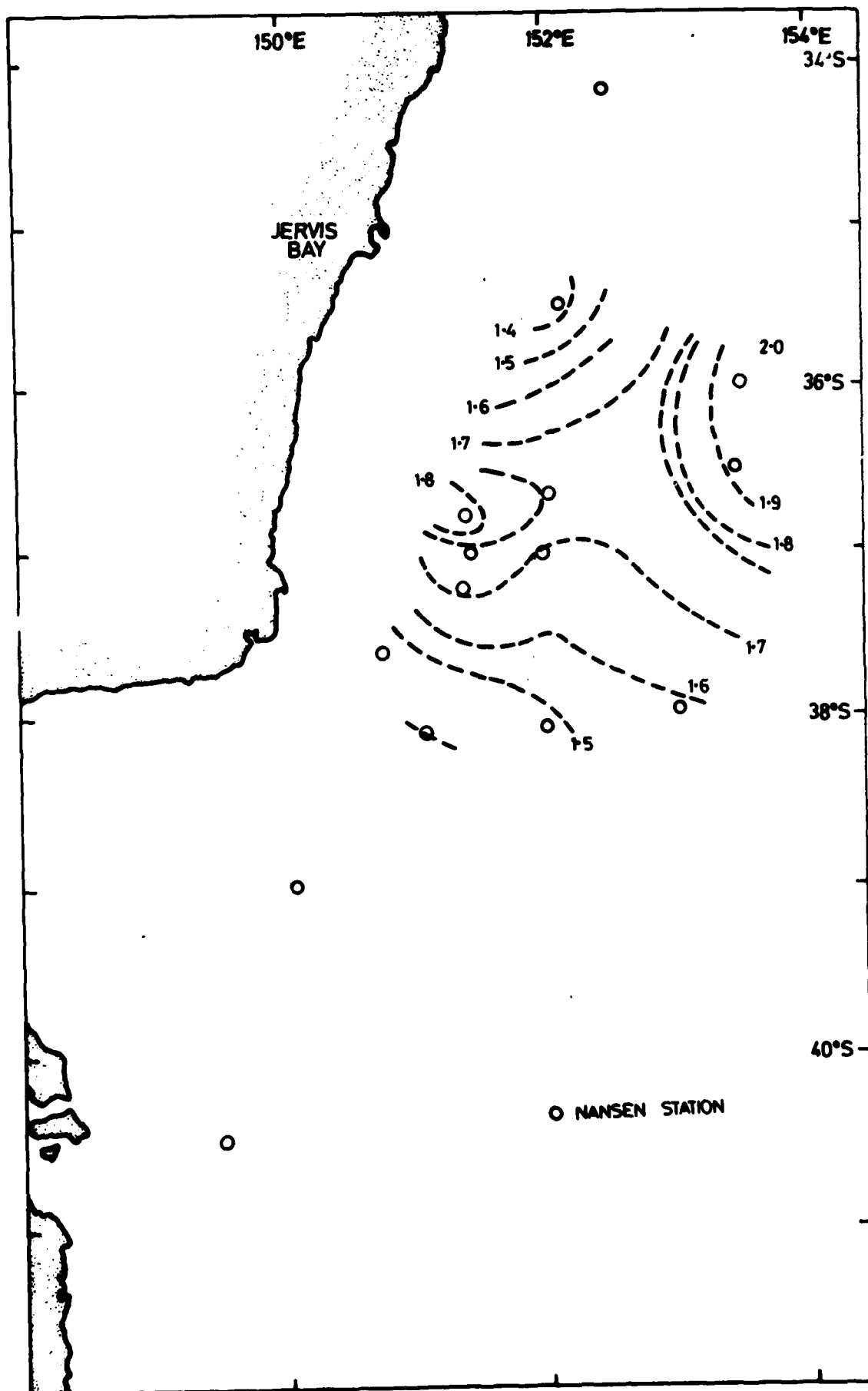


Fig.61. Dynamic Height relative to 1300m. Cruise SP 12/78.

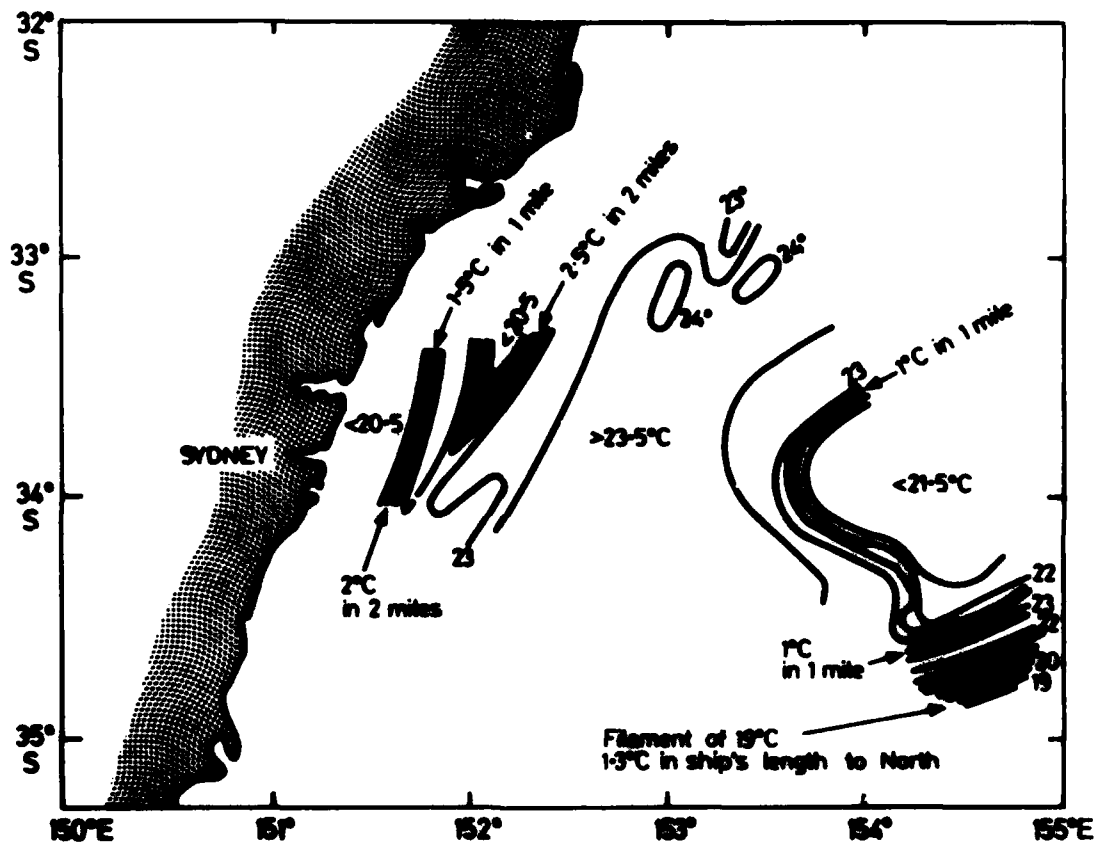


Fig.62 SST ($^{\circ}\text{C}$). Cruise SP 17/78. 9-11 Dec. 1978.

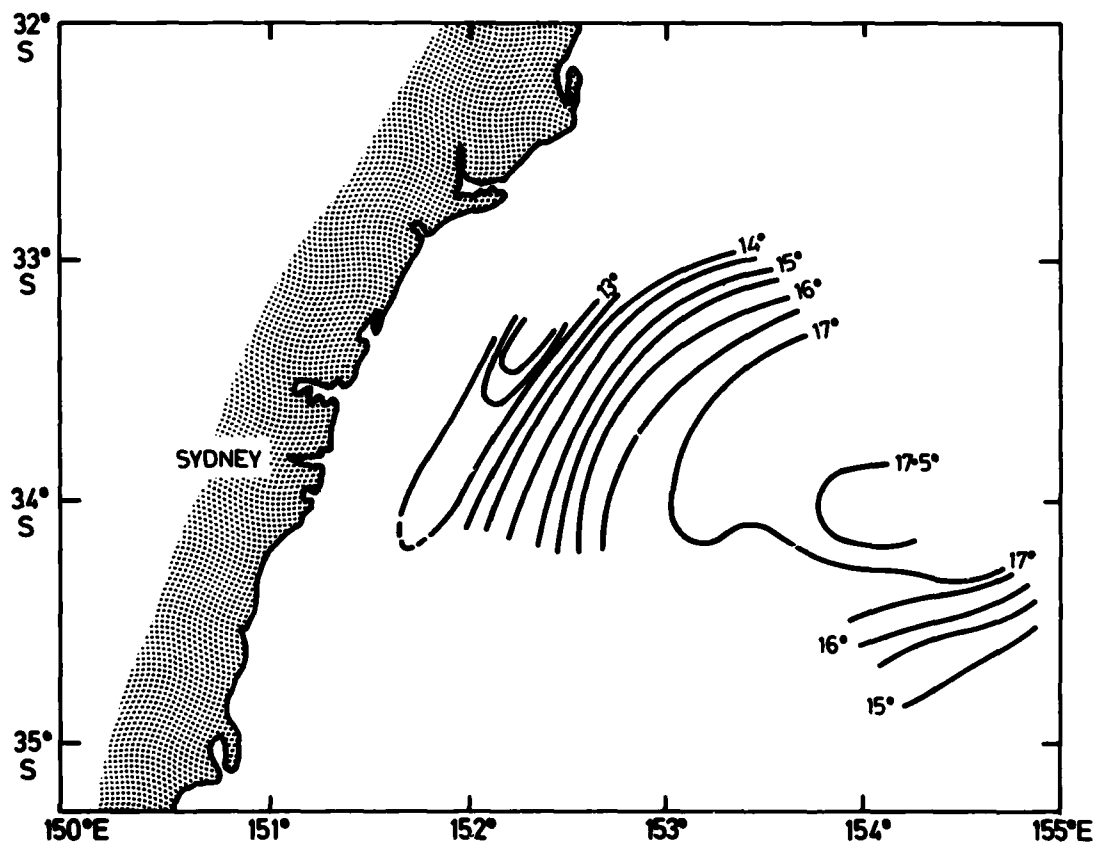


Fig.63. T₂₅₀ (°C). Cruise SP 17/78.

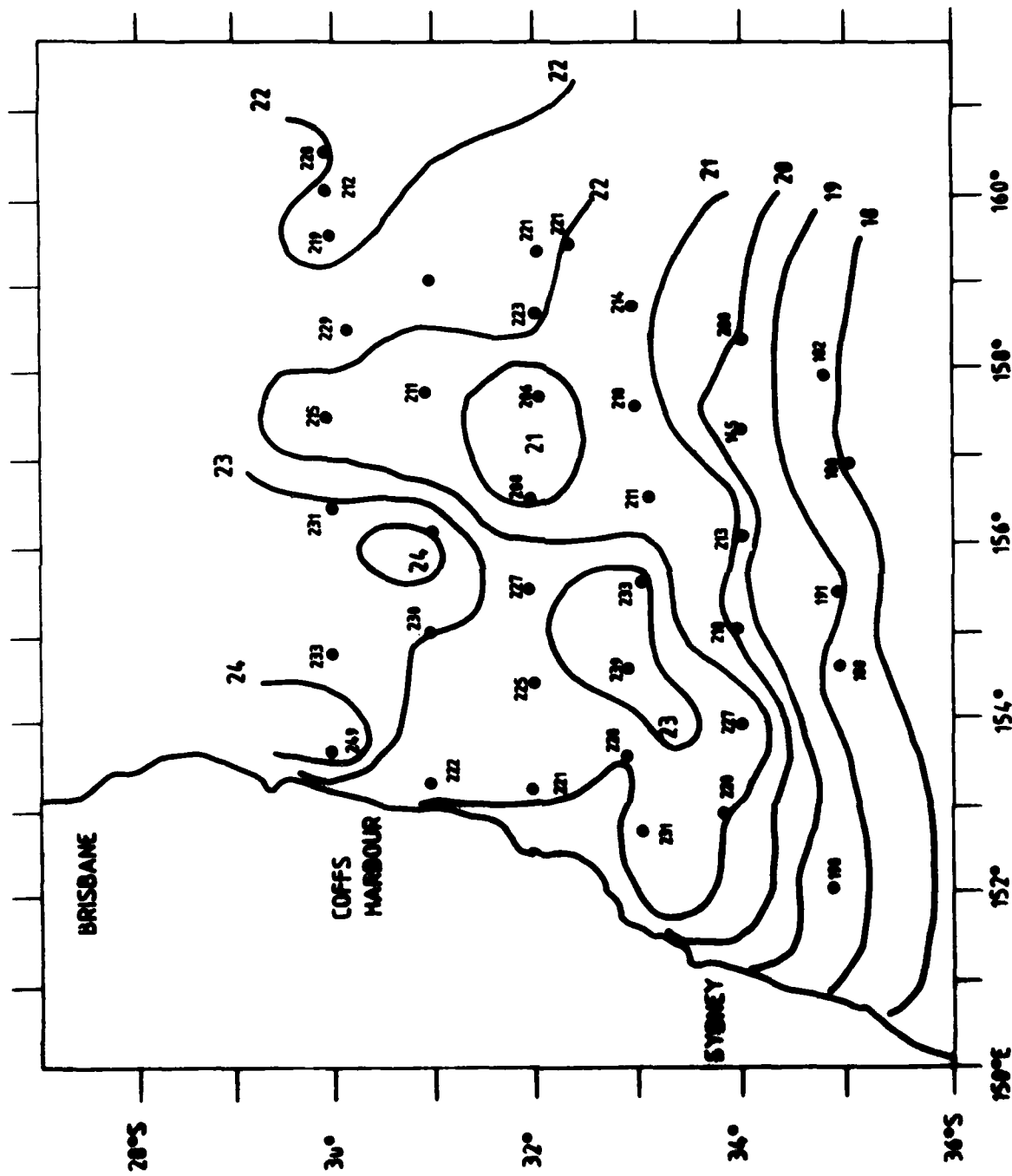


Fig. 64. Sea surface temperature (°C) AXBT survey 13 Dec. 1978.

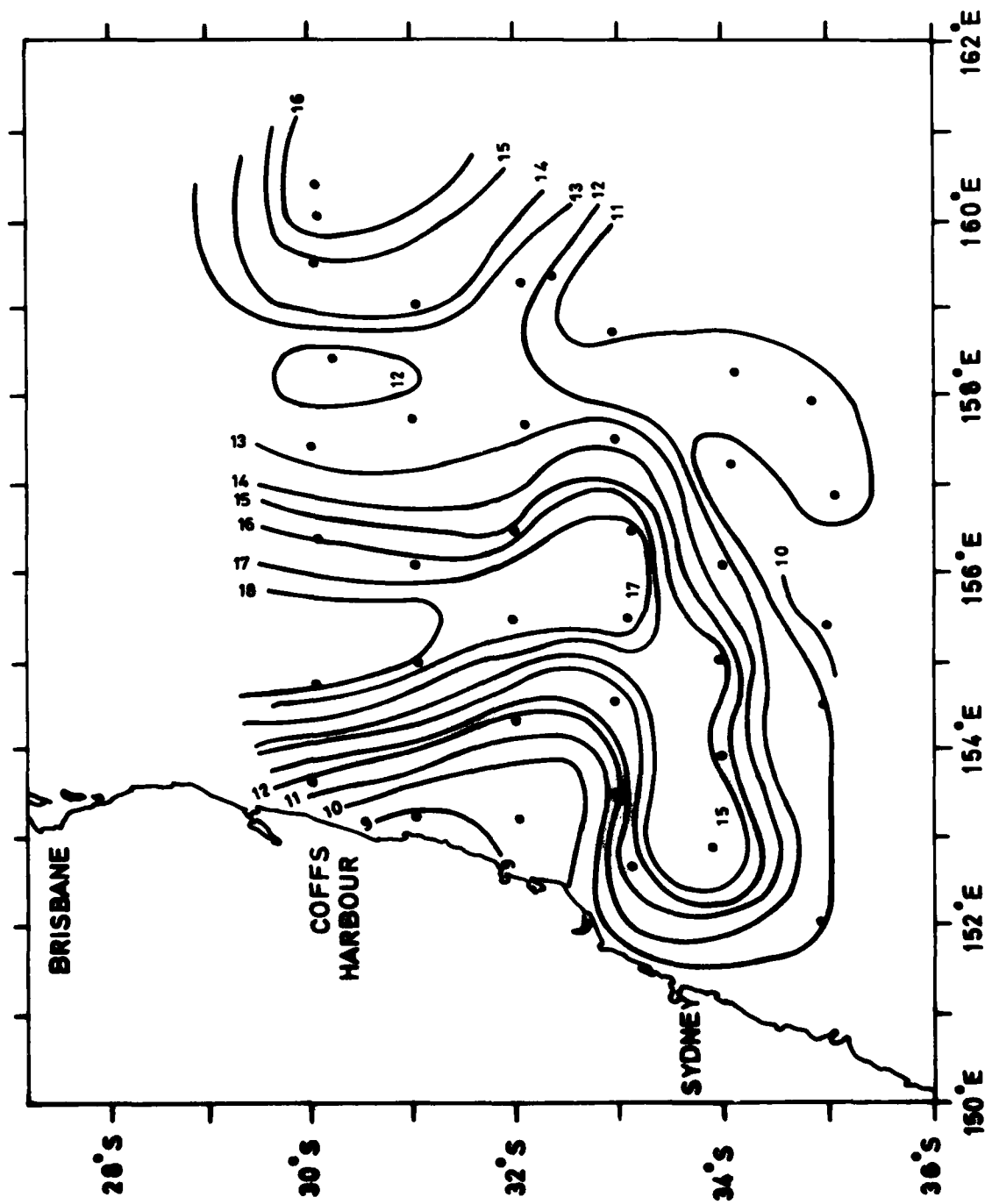


Fig. 65. T250 AXBT Survey 13 Dec. 1978.

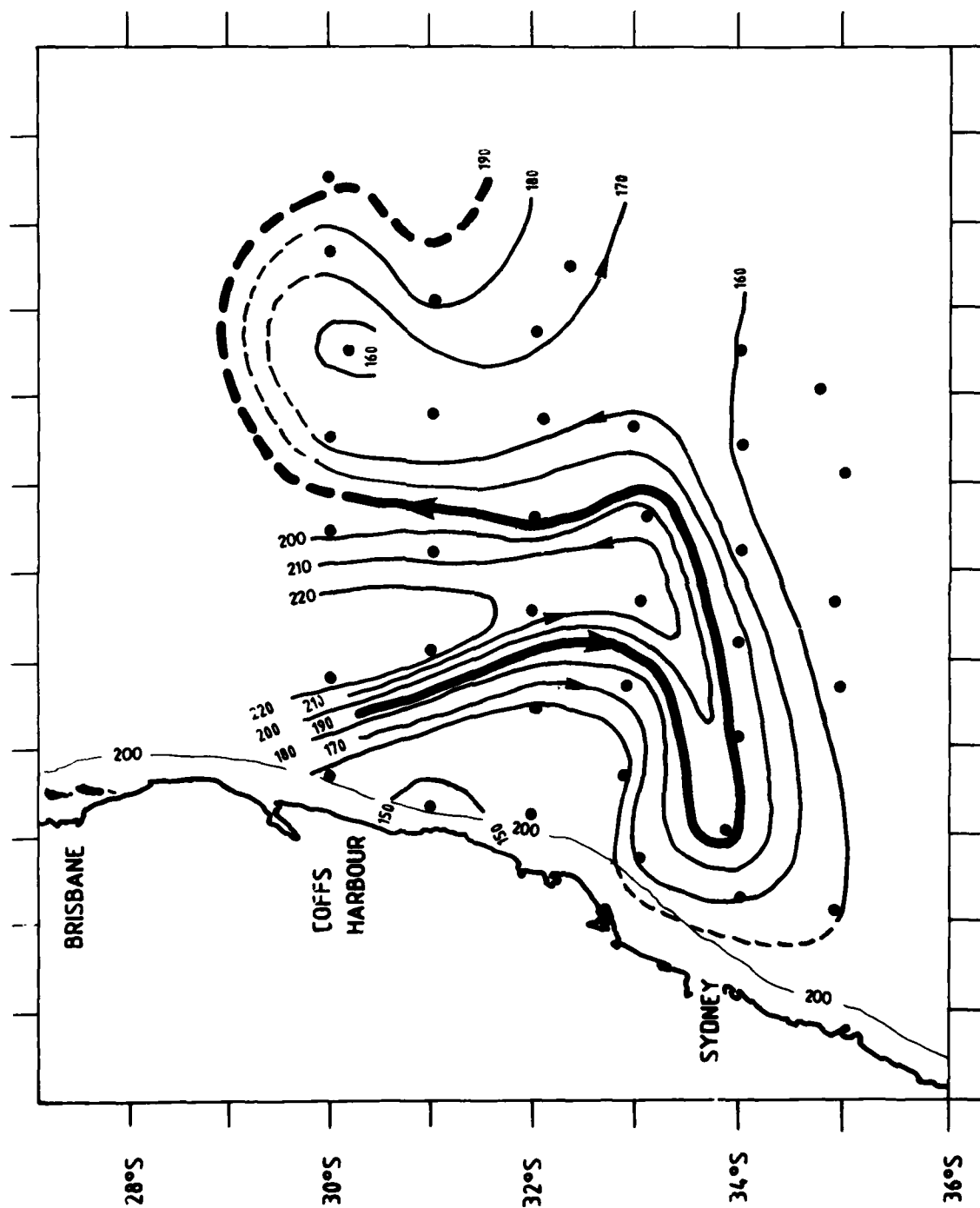


Fig. 66. Dynamic height anomaly (0 re 1300 dbar in dyn cm) deduced from AXBT probes
 (13 Dec. 1978, filled circles).

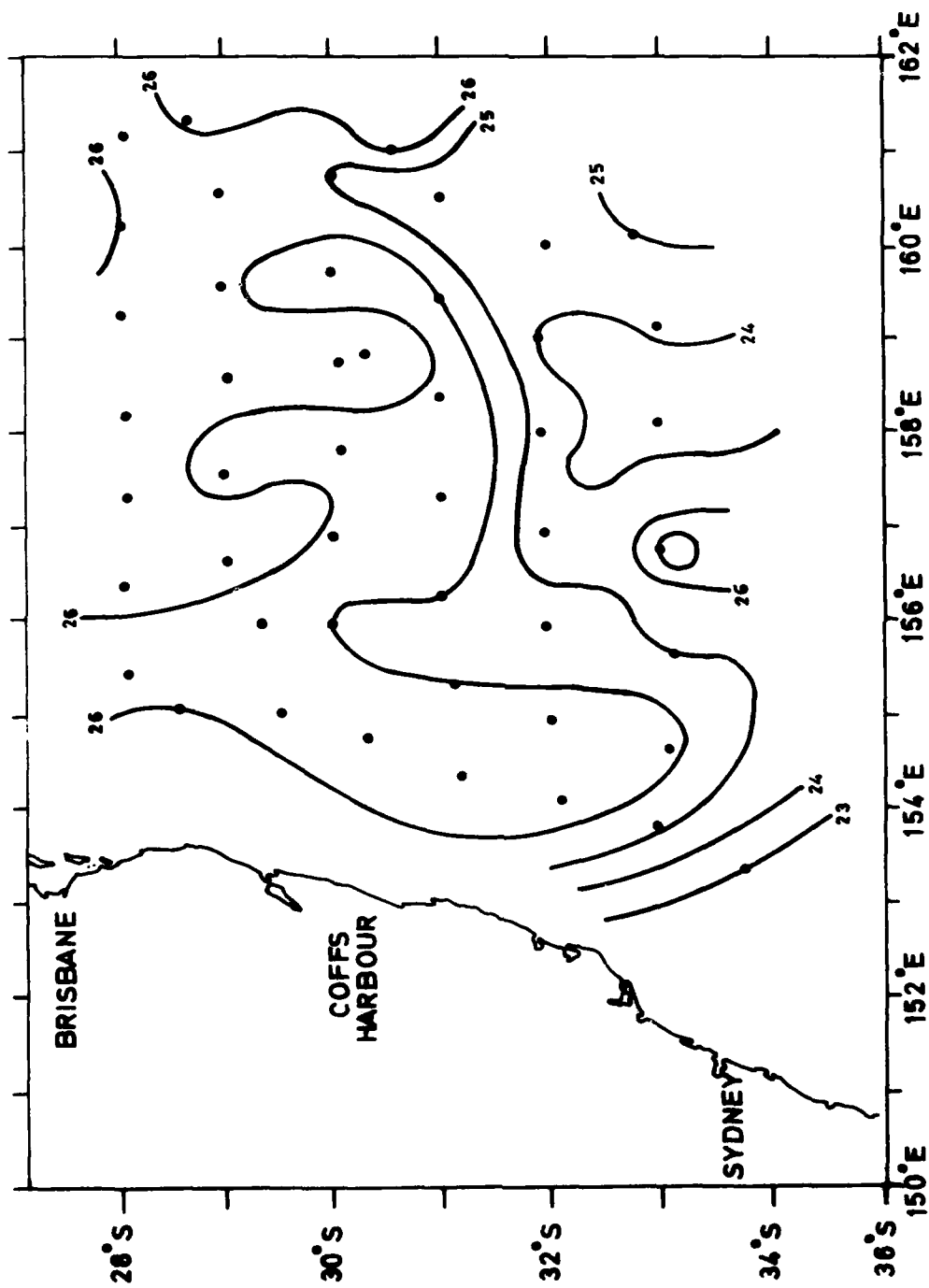


Fig. 67. S.S.T. (°C) H.M.A.S. Kimbla 11-19 Feb. 1979

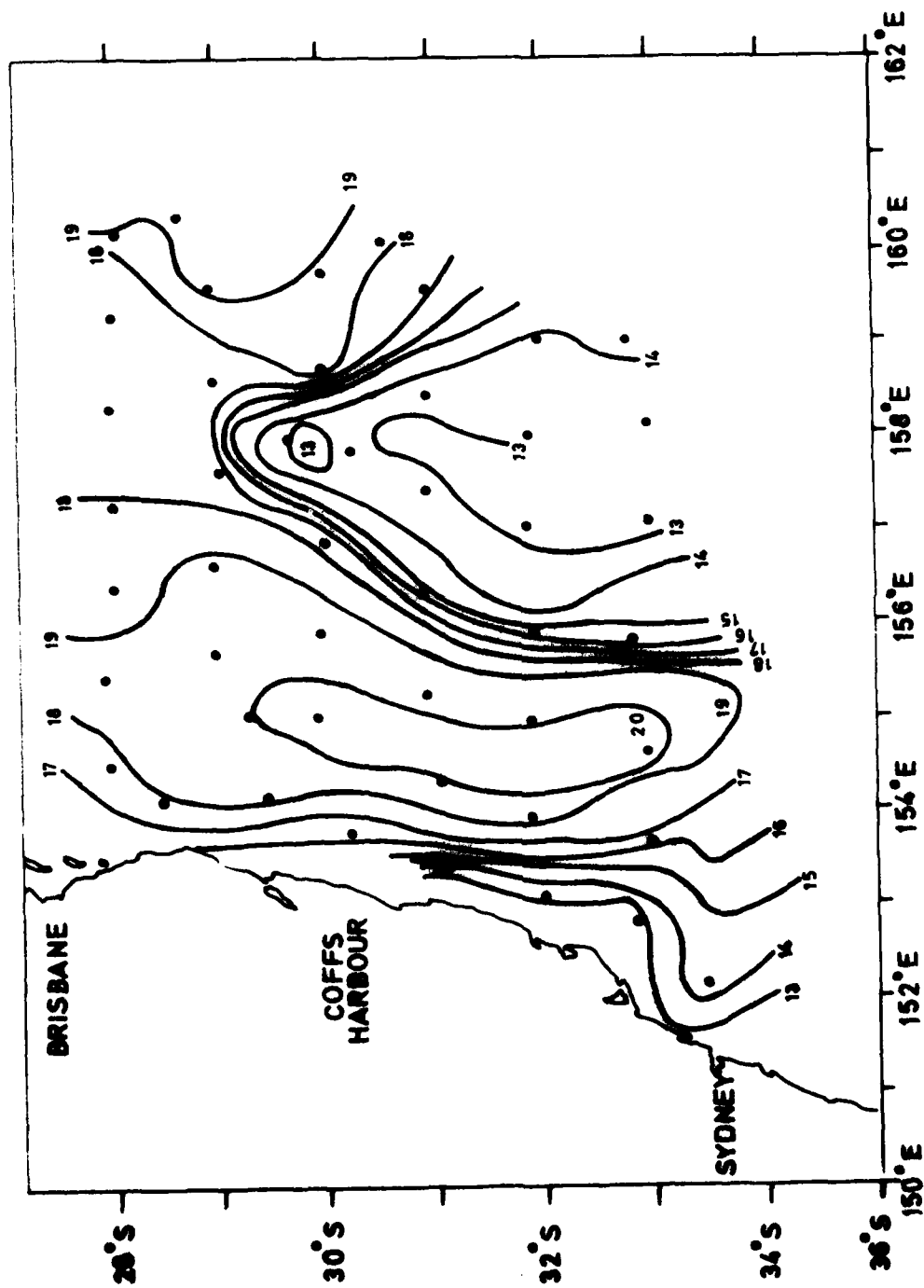


Fig. 68. T250 H.M.A.S. Kimbla 11-19 Feb. 1979.

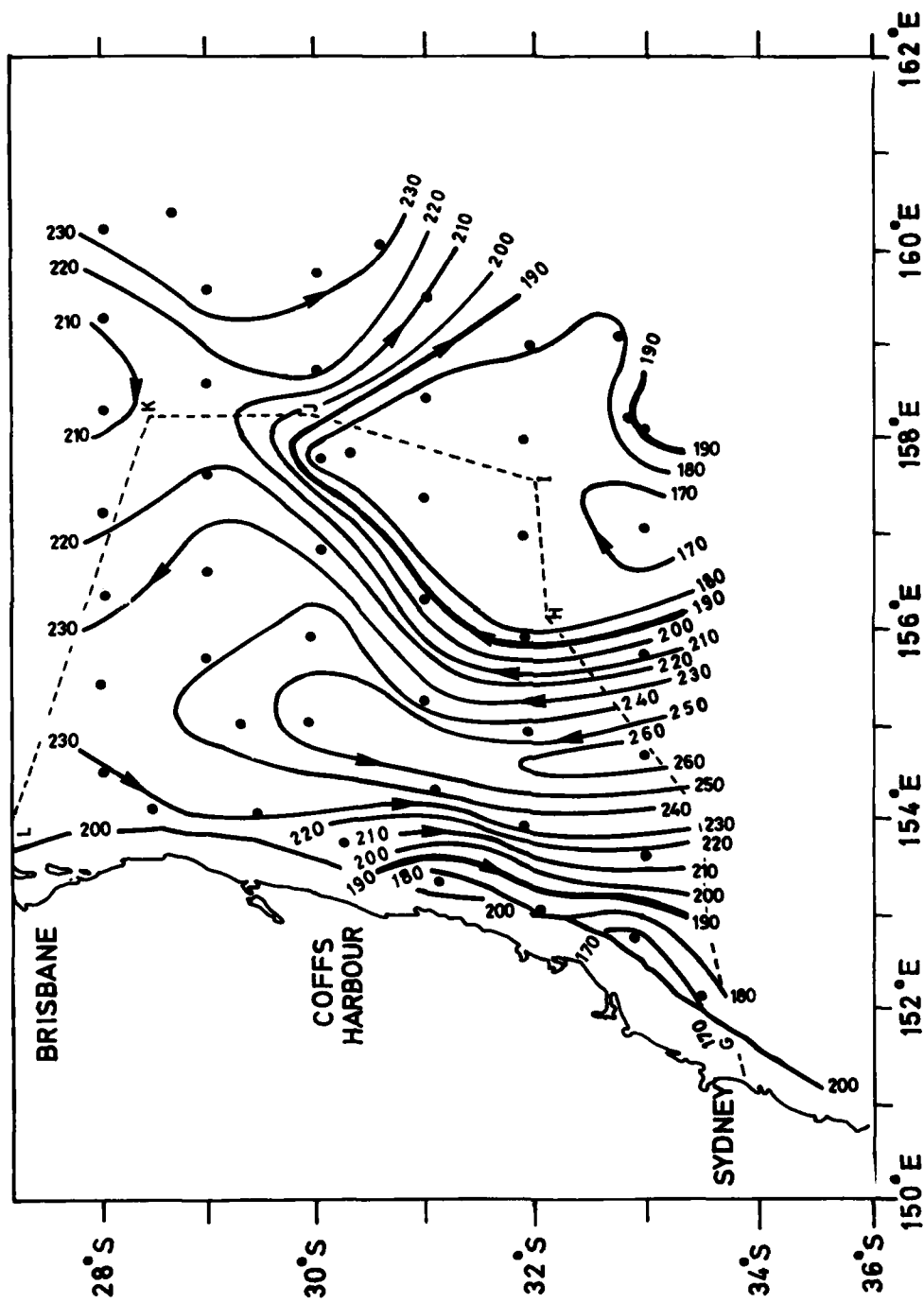


Fig.69. Dynamic height anomaly (0 to 1300 dbar in dyn cm) deduced from AXBT probes (8 Feb. 1979, filled circles) and XBT probes along GHIJKL (HMAS Kimbla, 11 to 19 Feb. 1979).

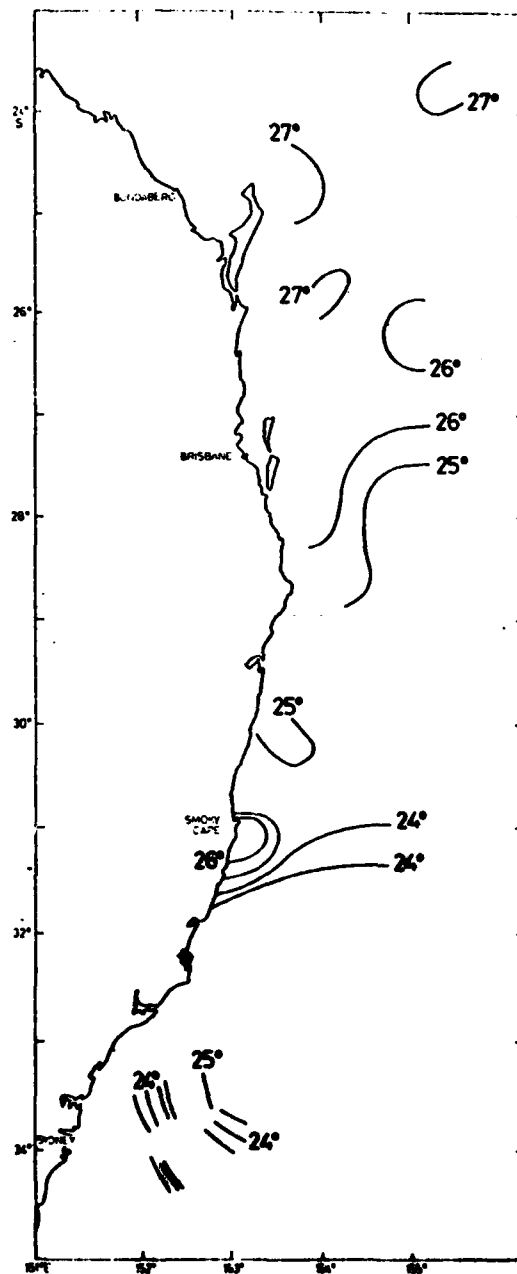


Fig. 70. SST (°C), Cruise SP 3/79, 18-28 March 1979.

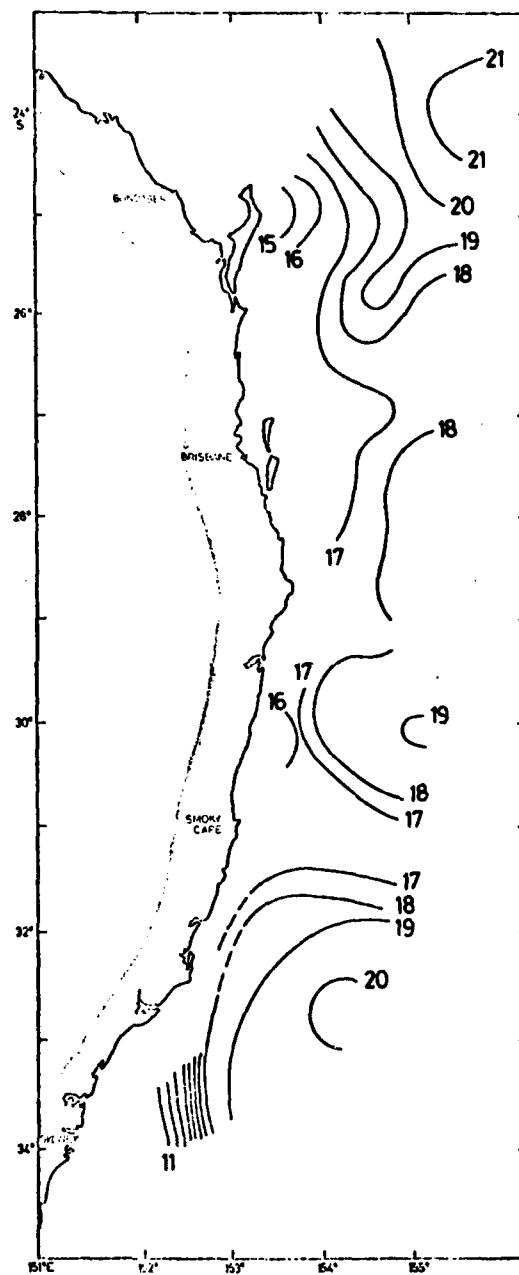


Fig. 71. T_{250} (°C). Cruise SP 3/79.

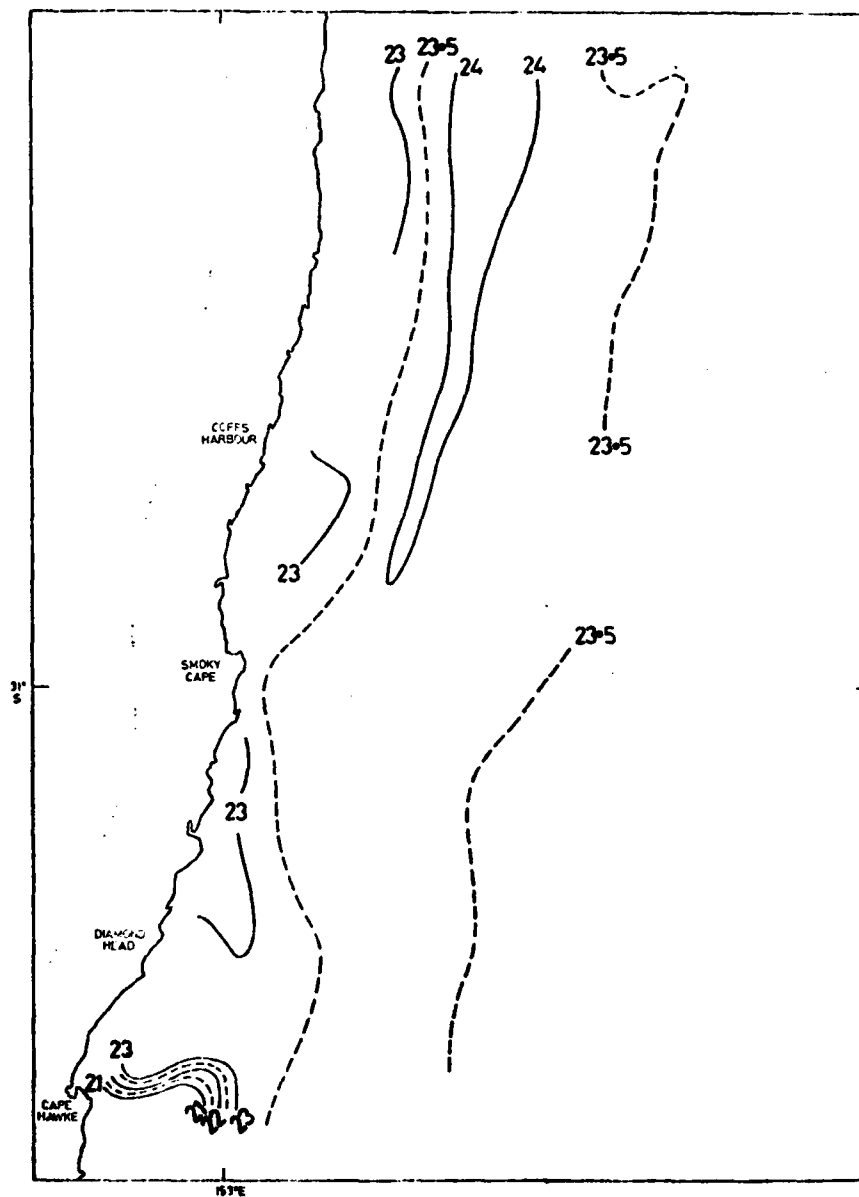


Fig. 72. SST ($^{\circ}$ C). Cruise SP 6/79. (Part 1). 10-22 May 1979.

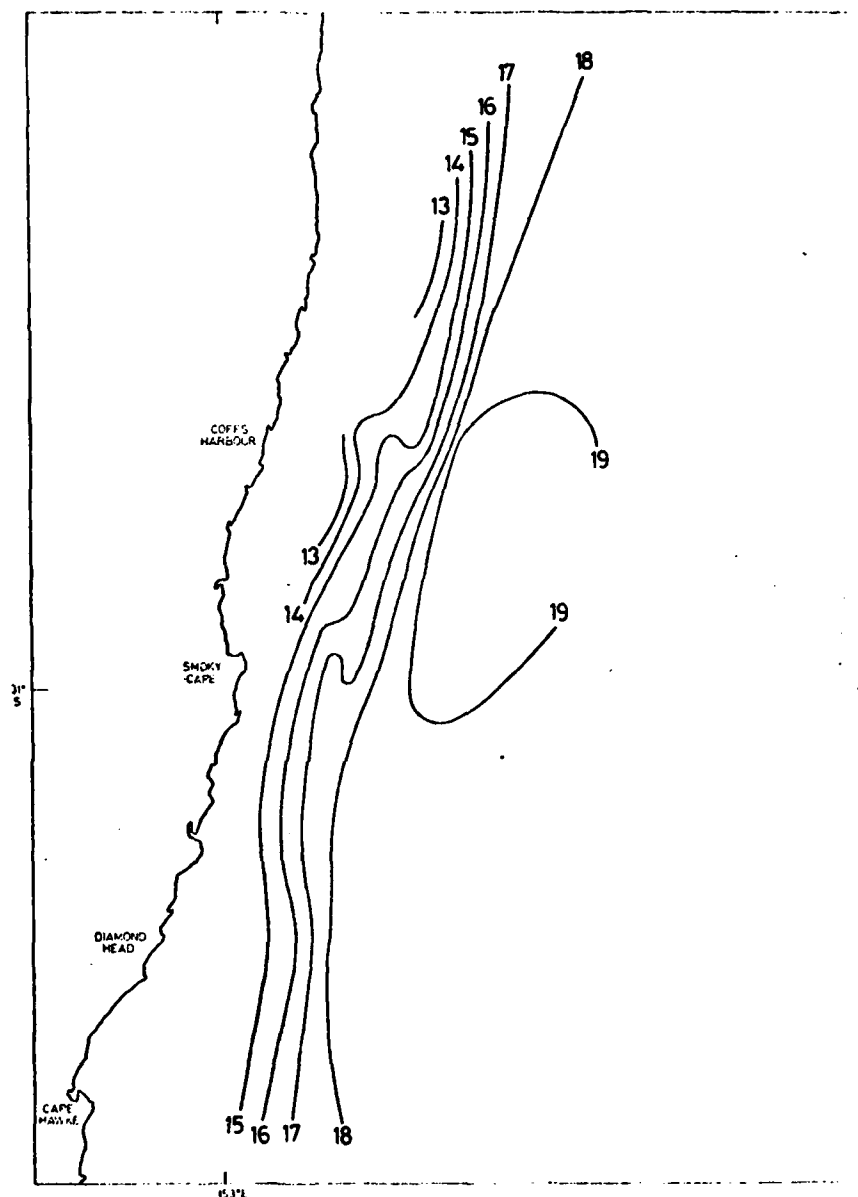


Fig.73. T_{250} (°C). Cruise SP 6/79. (Part 1).

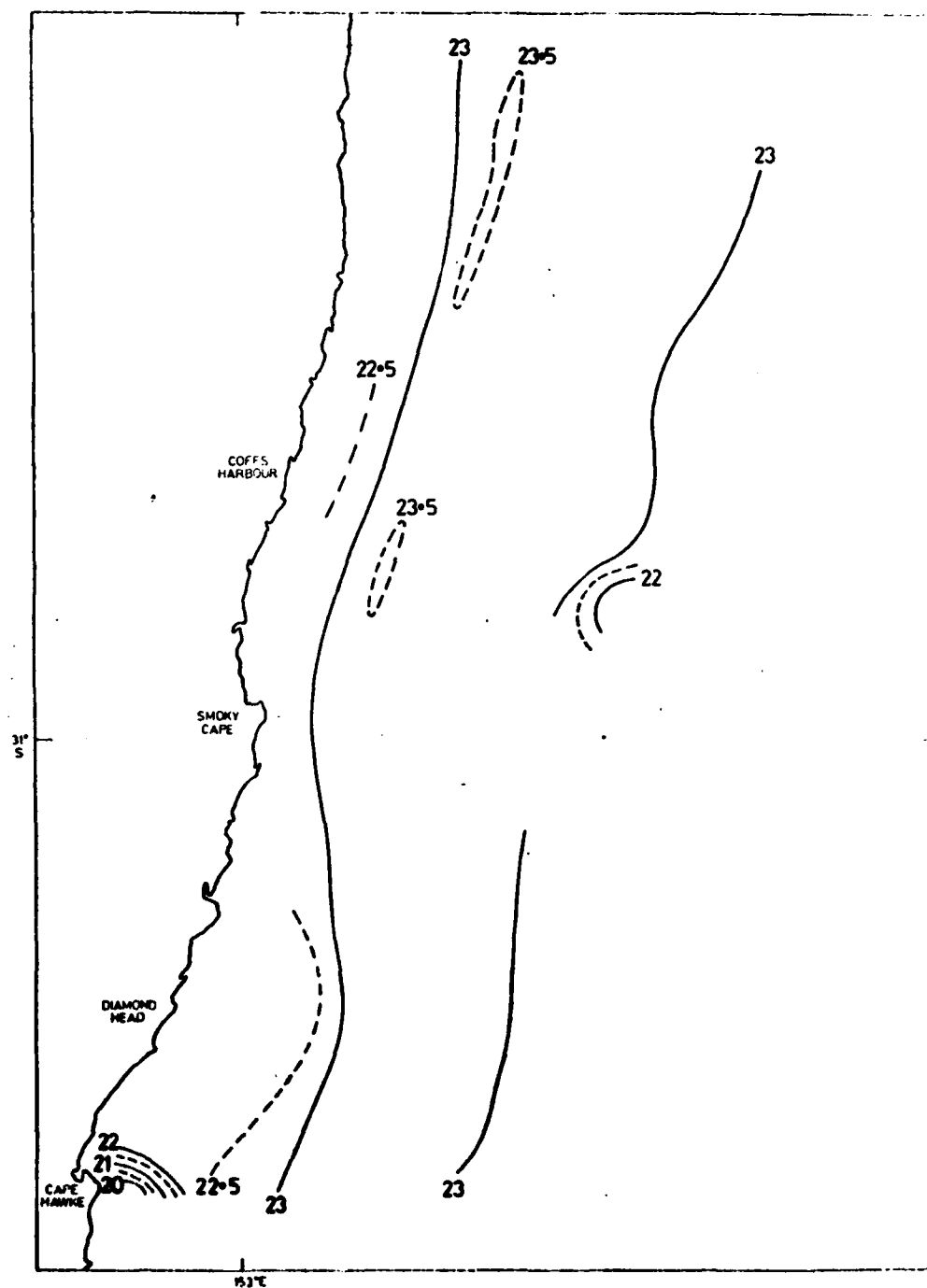


Fig. 74. SST(°C). Cruise SP6/79. (Part 2).

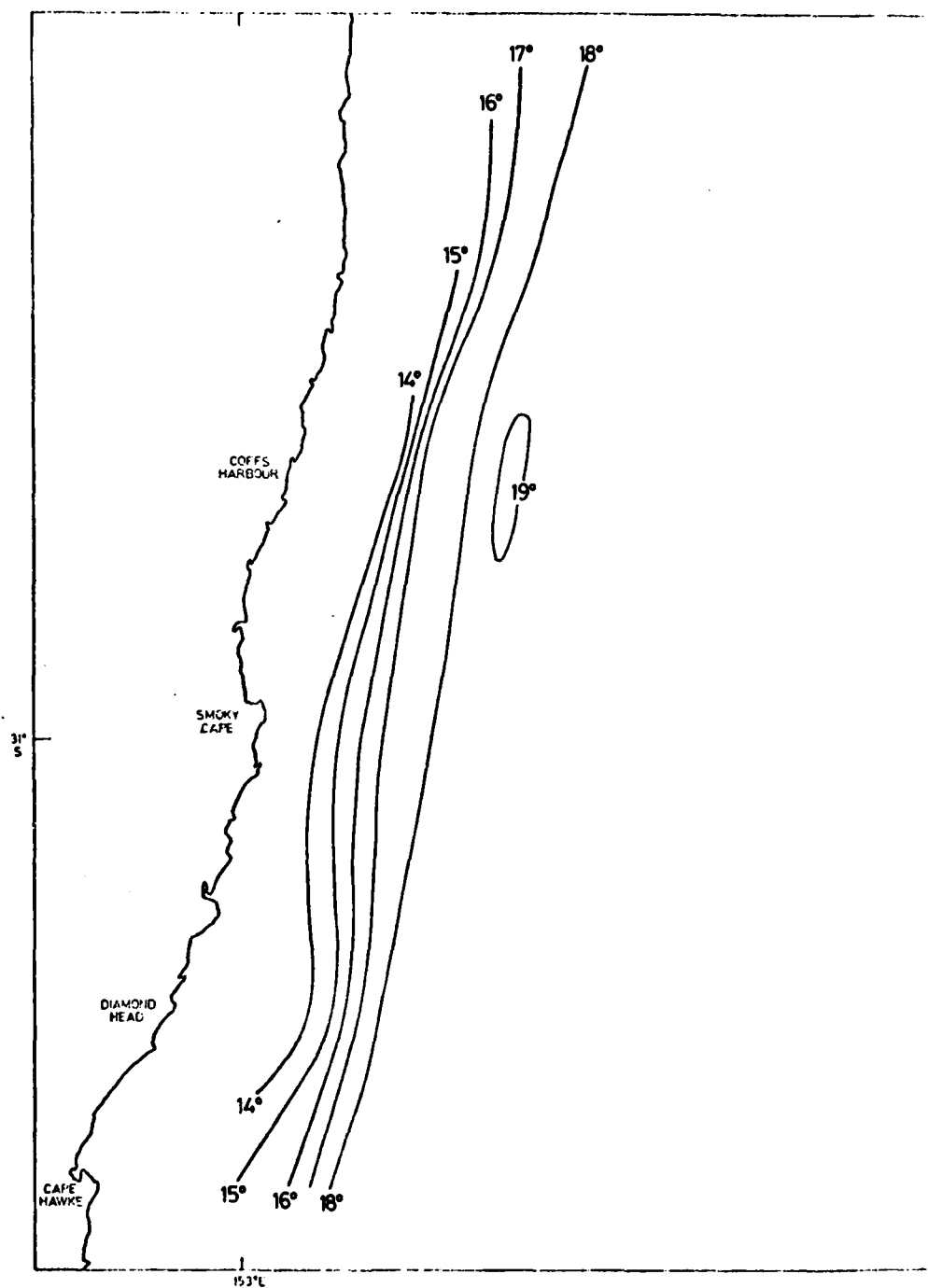


Fig.75. T_{250} (°C). Cruise SP6/79. (Part 2).

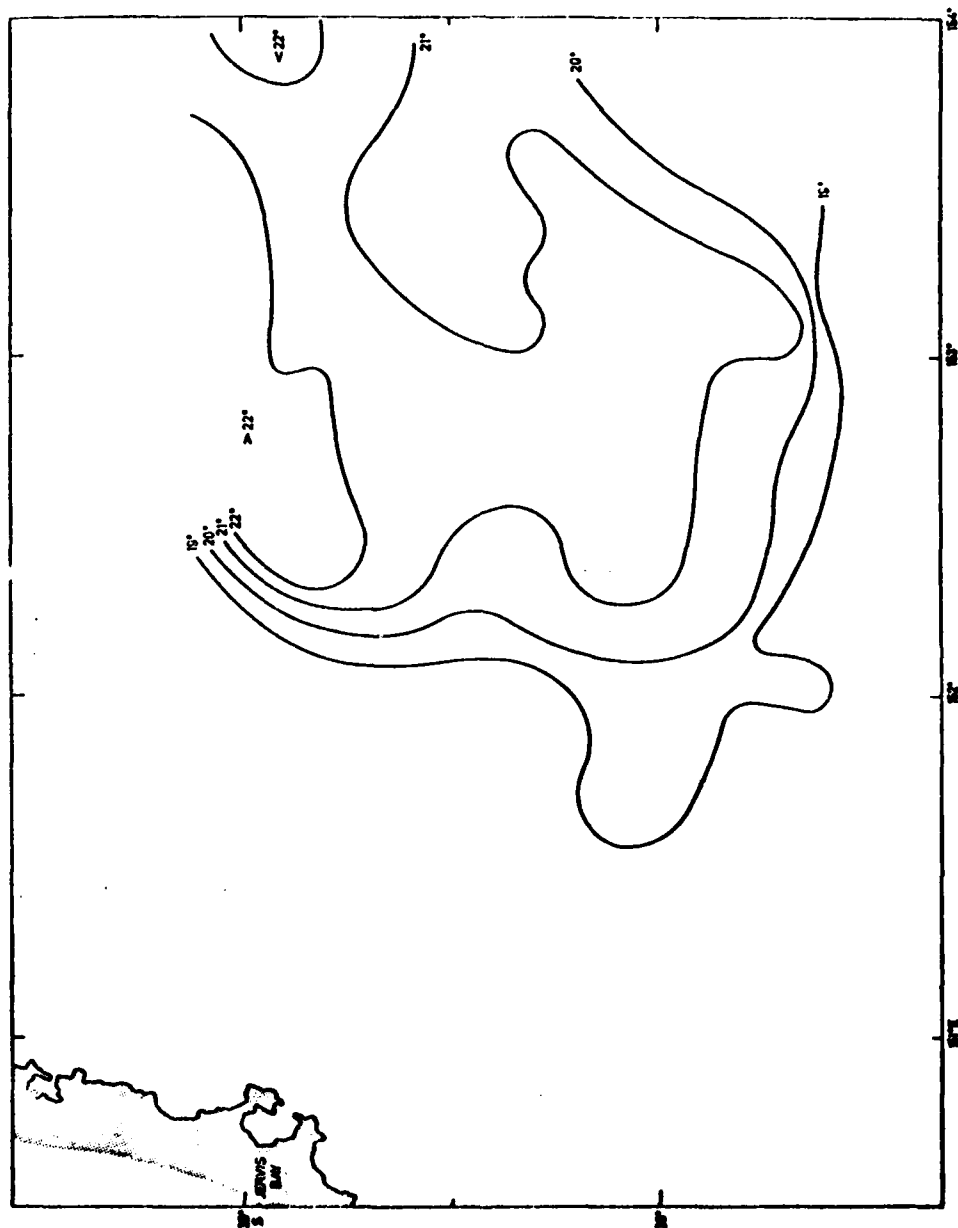


Fig. 76. SST (°C), Cruise SP 779 (lat survey), 23 May - 6 June 1978.

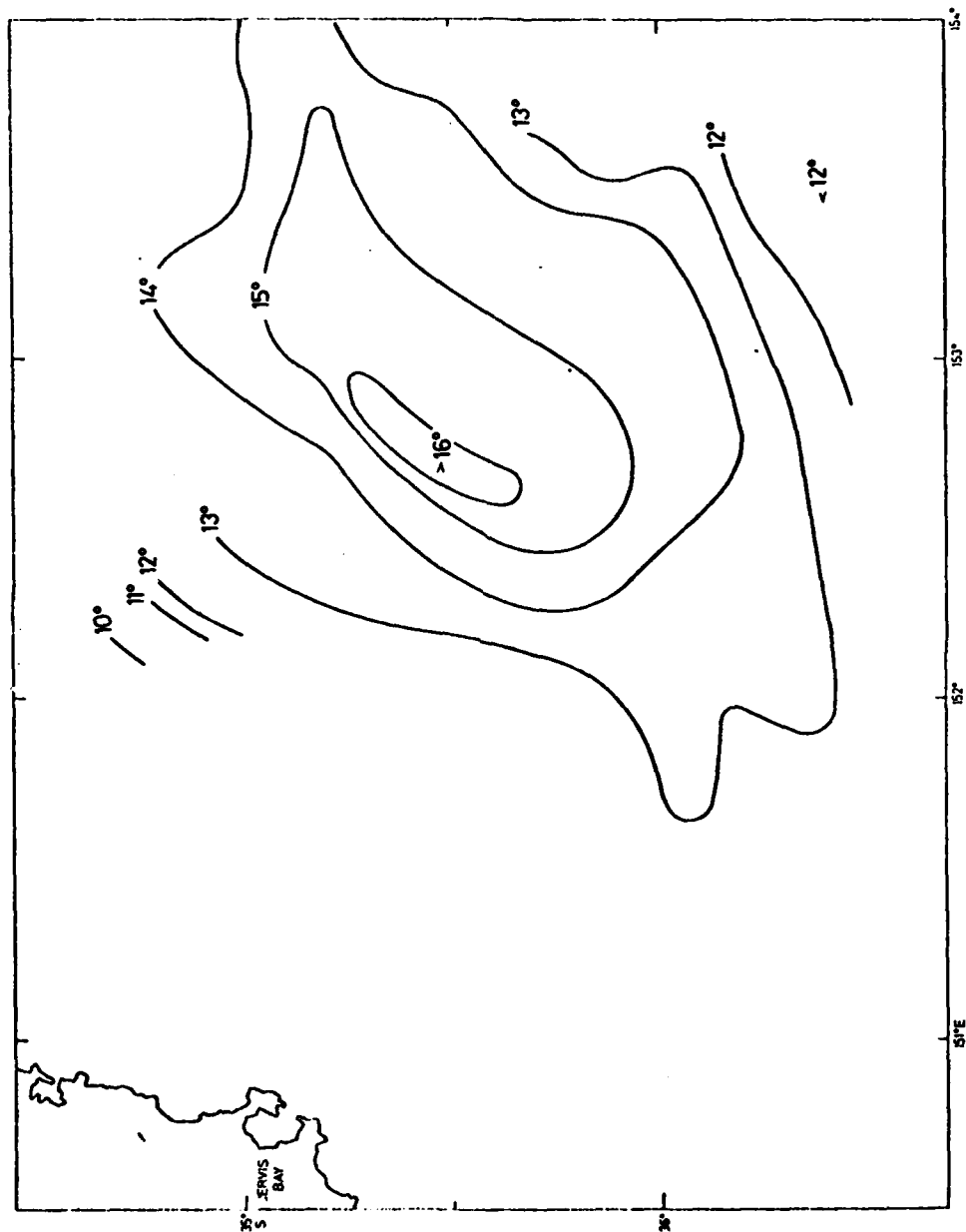


Fig. 77. T_{250} ($^{\circ}\text{C}$). Cruise SP7779 (1st survey).

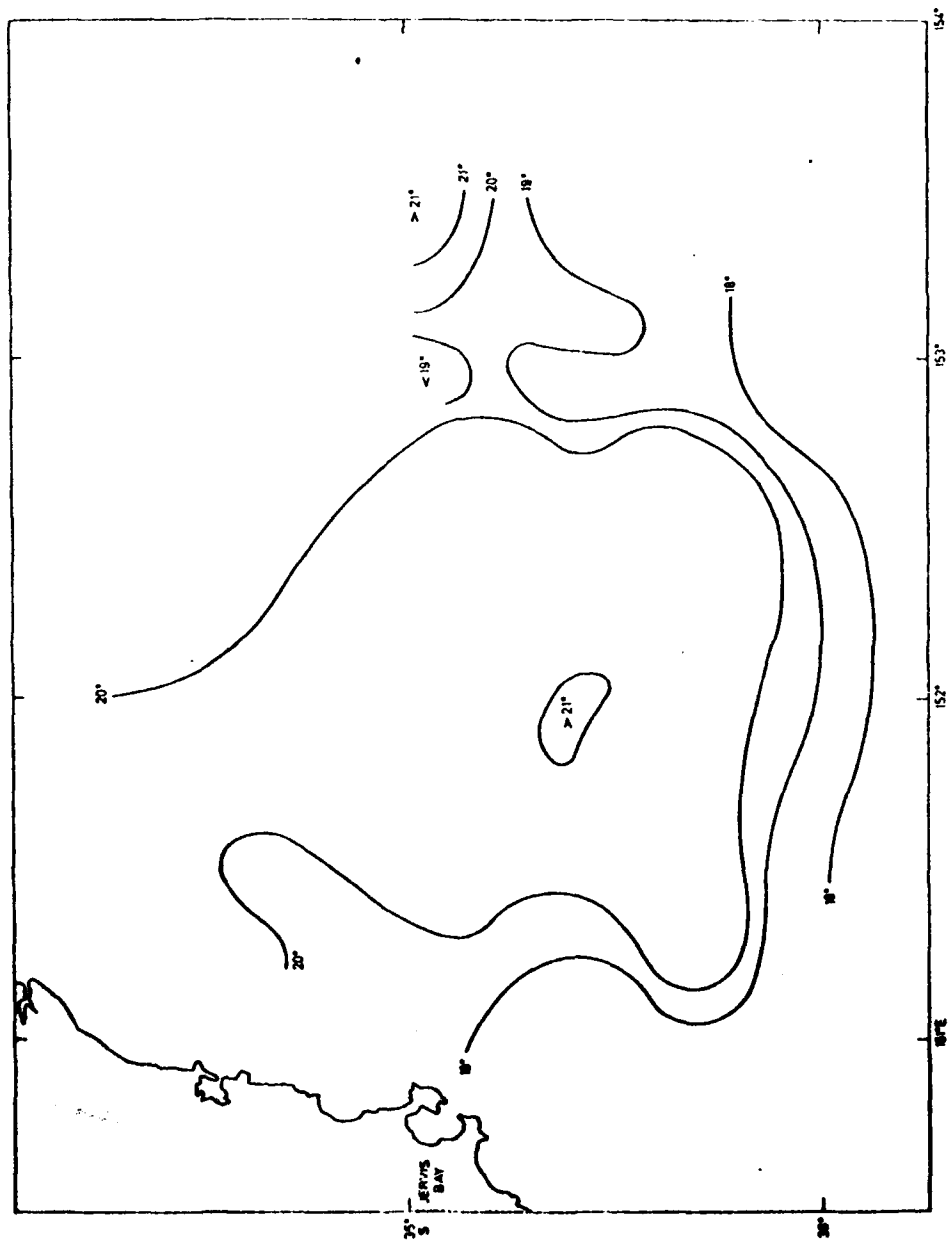


Fig. 76. SST (°C). Cruise SP 7/79. (2nd survey).

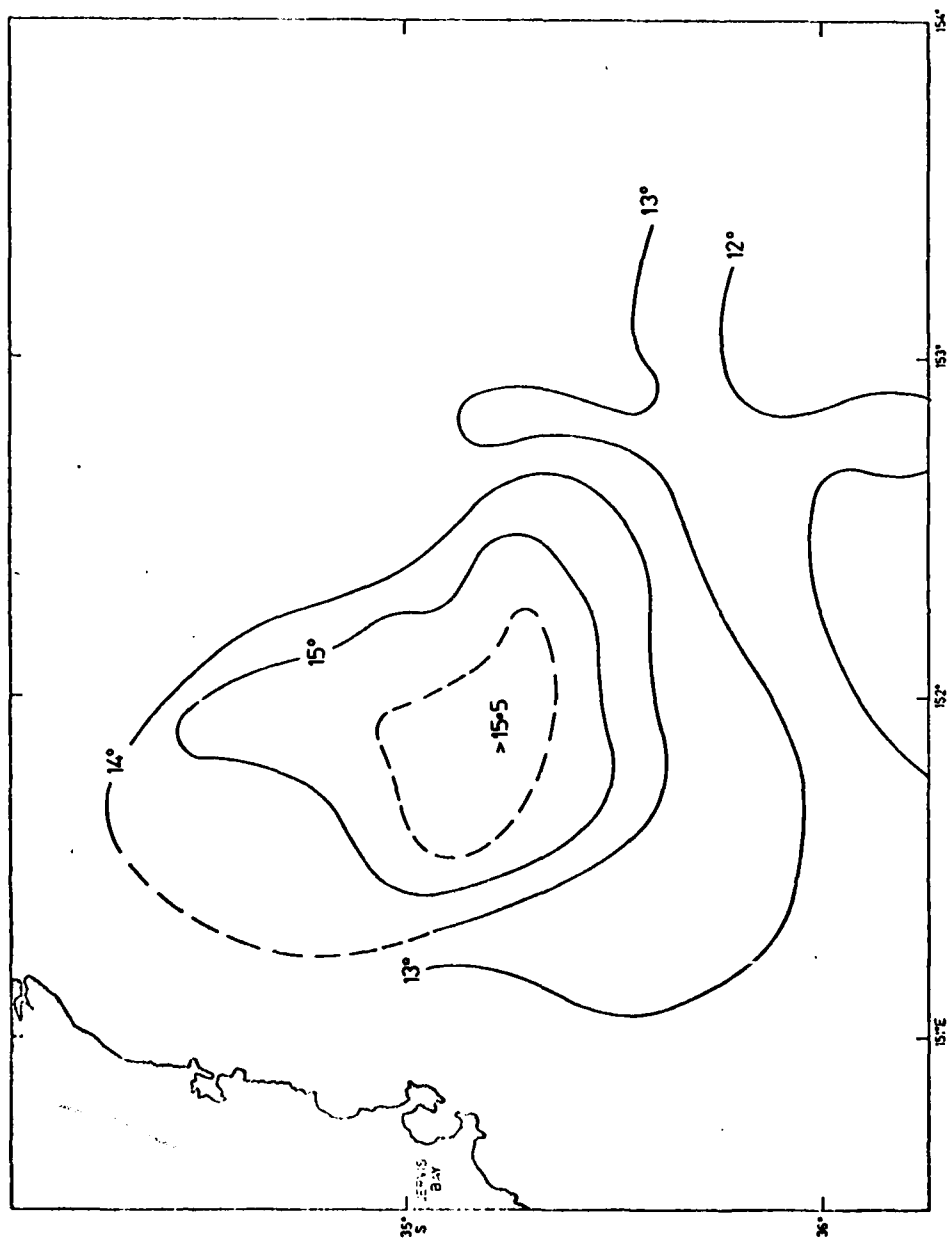


Fig.79. T_{250} (°C). Cruise SP 7/79. (2nd survey).

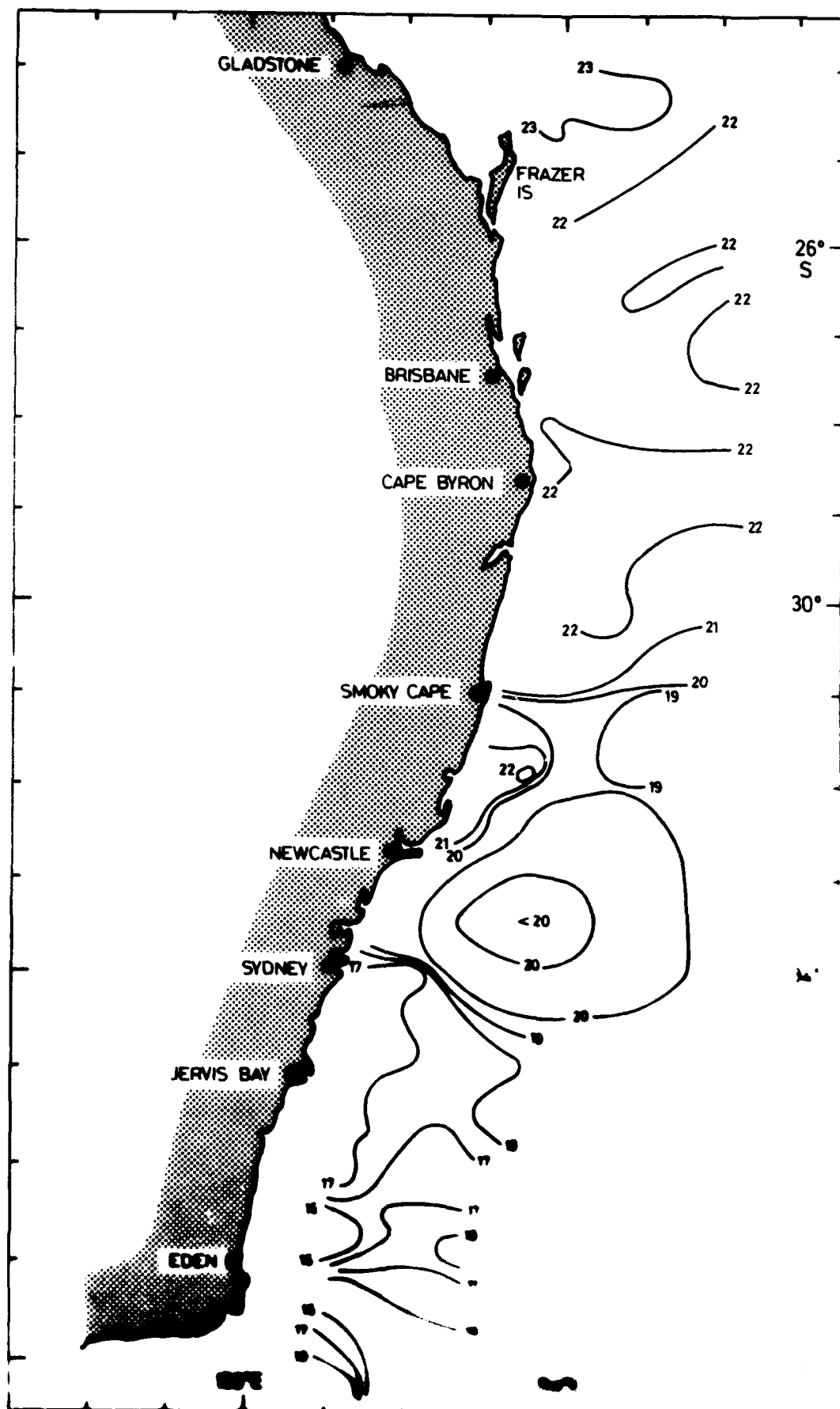


Fig. 80 SST (°C) Contour 2° 0.5° 1° 1.5° 2°

COMPARISONS BETWEEN PATTERNS OF SEA-SURFACE TEMPERATURE
AND SUB-SURFACE P. (U) ROYAL AUSTRALIAN NAVY RESEARCH
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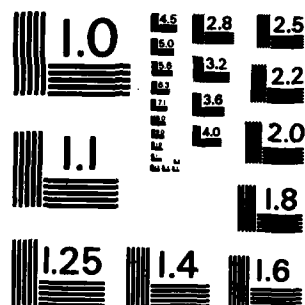
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RANRL-TM(EXT)-8/82

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MICROCOPY RESOLUTION TEST CHART
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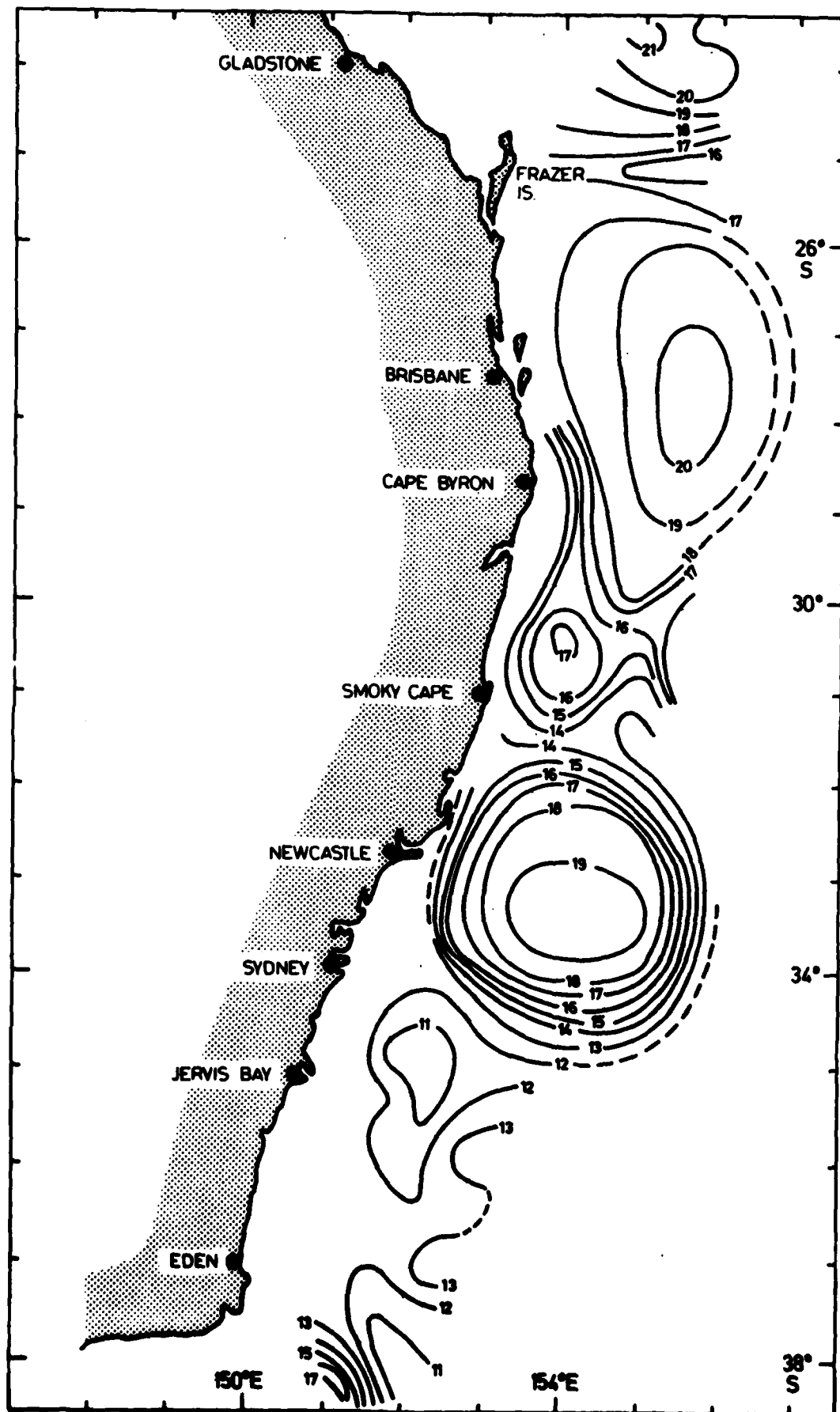


Fig. 81. T₂₅₀ (°C). Cruise SP 8/79.

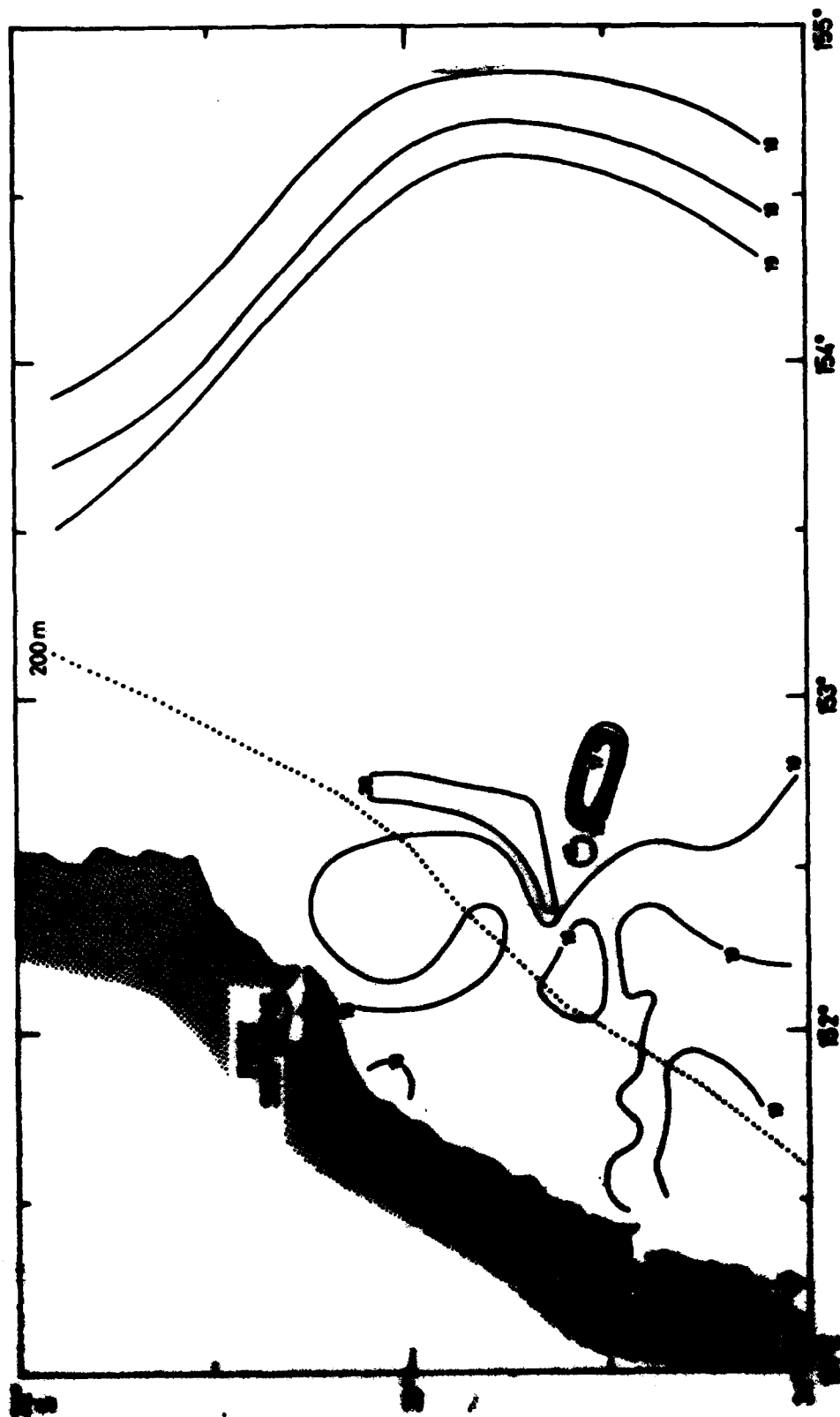


Fig. 82. SST (°C). Cruise SP 9/79. 17-31 Aug. 1979.

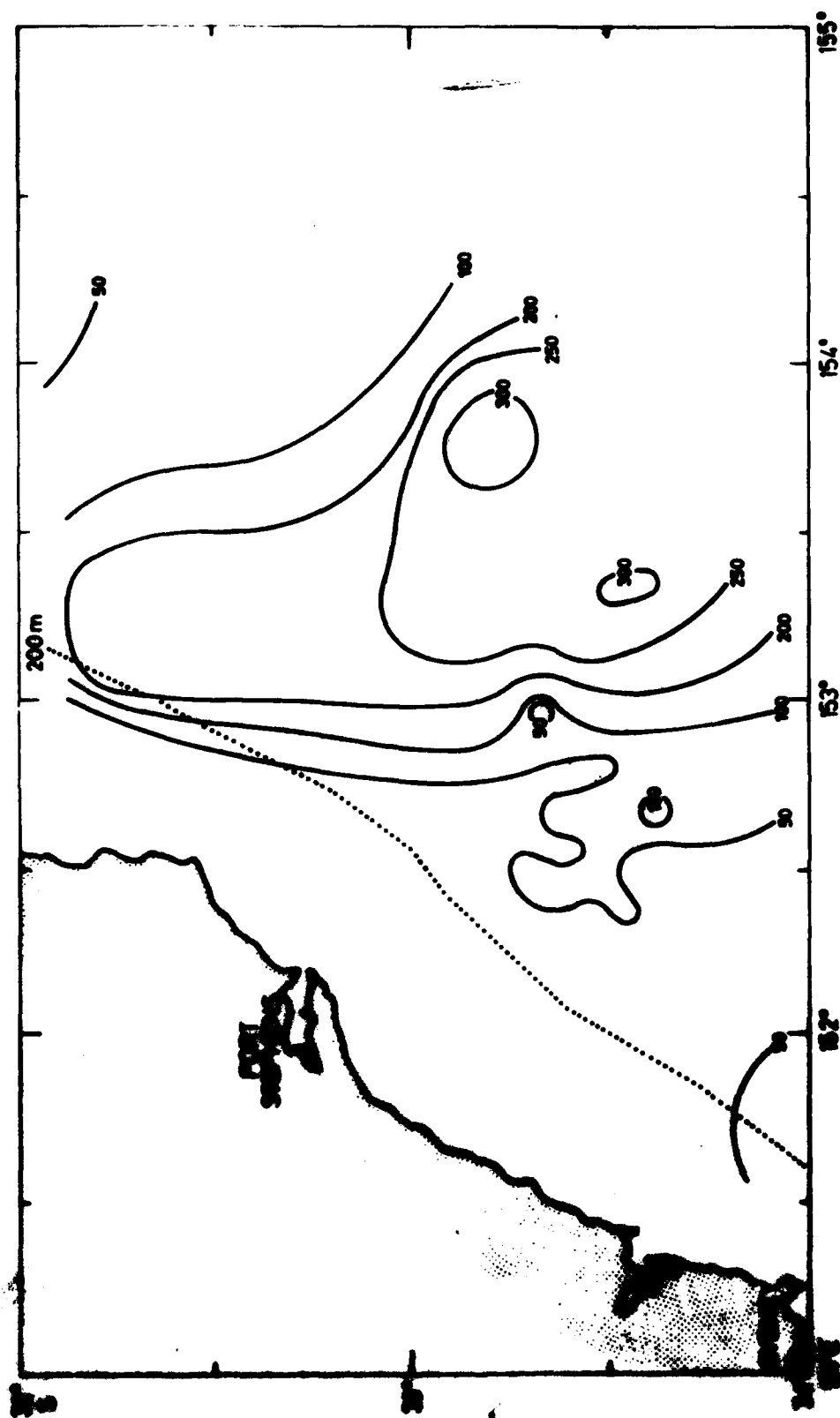


Fig.83. Depth of the mixed layer (m). SP9/79 17 -31 Aug.1979.

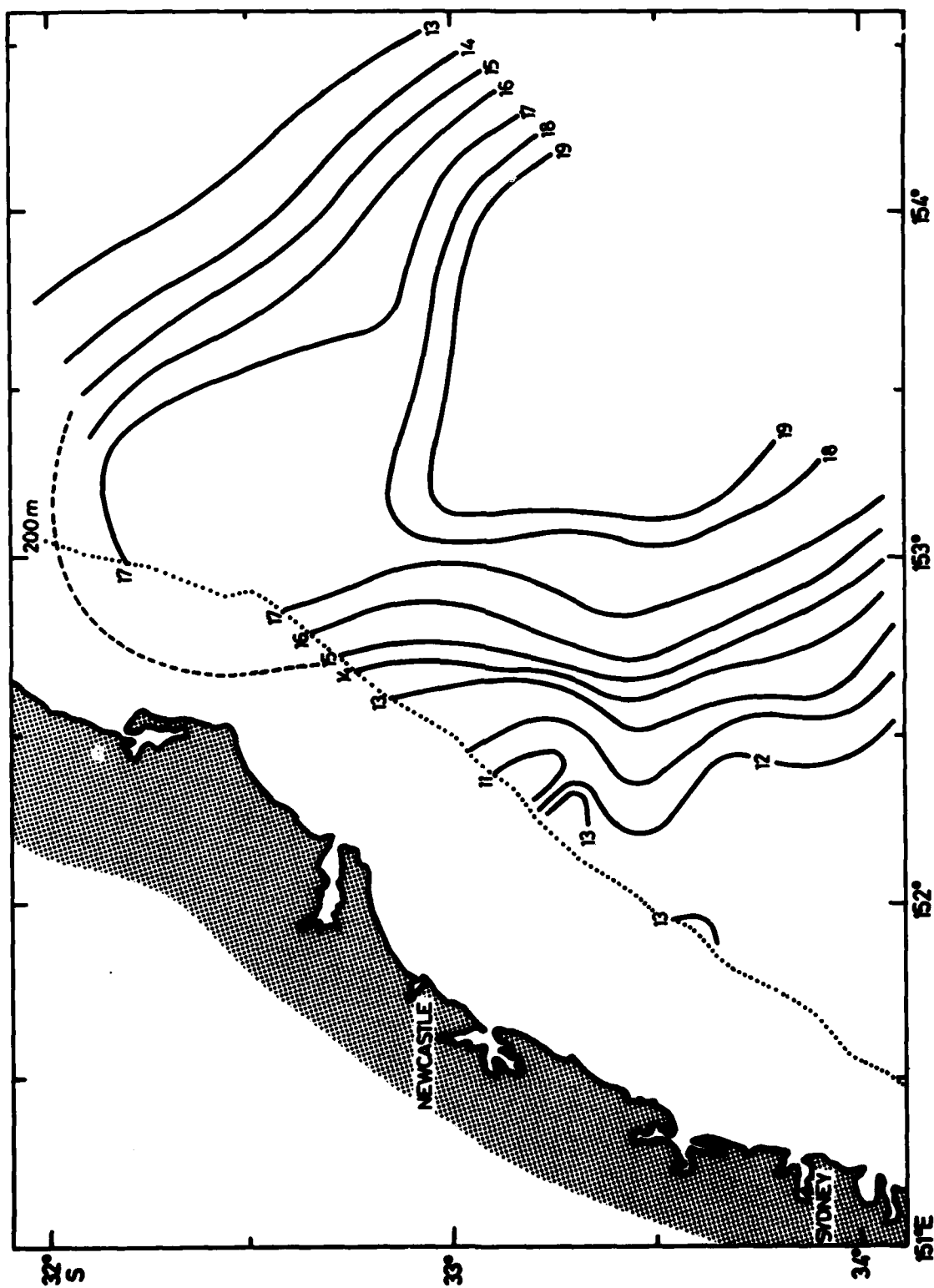


Fig. 84. Location of eddy "J" during SP 9/79 as indicated by the isotherm topography at 250 m. The boundaries of the eddy approximate to the 15°C isotherm.

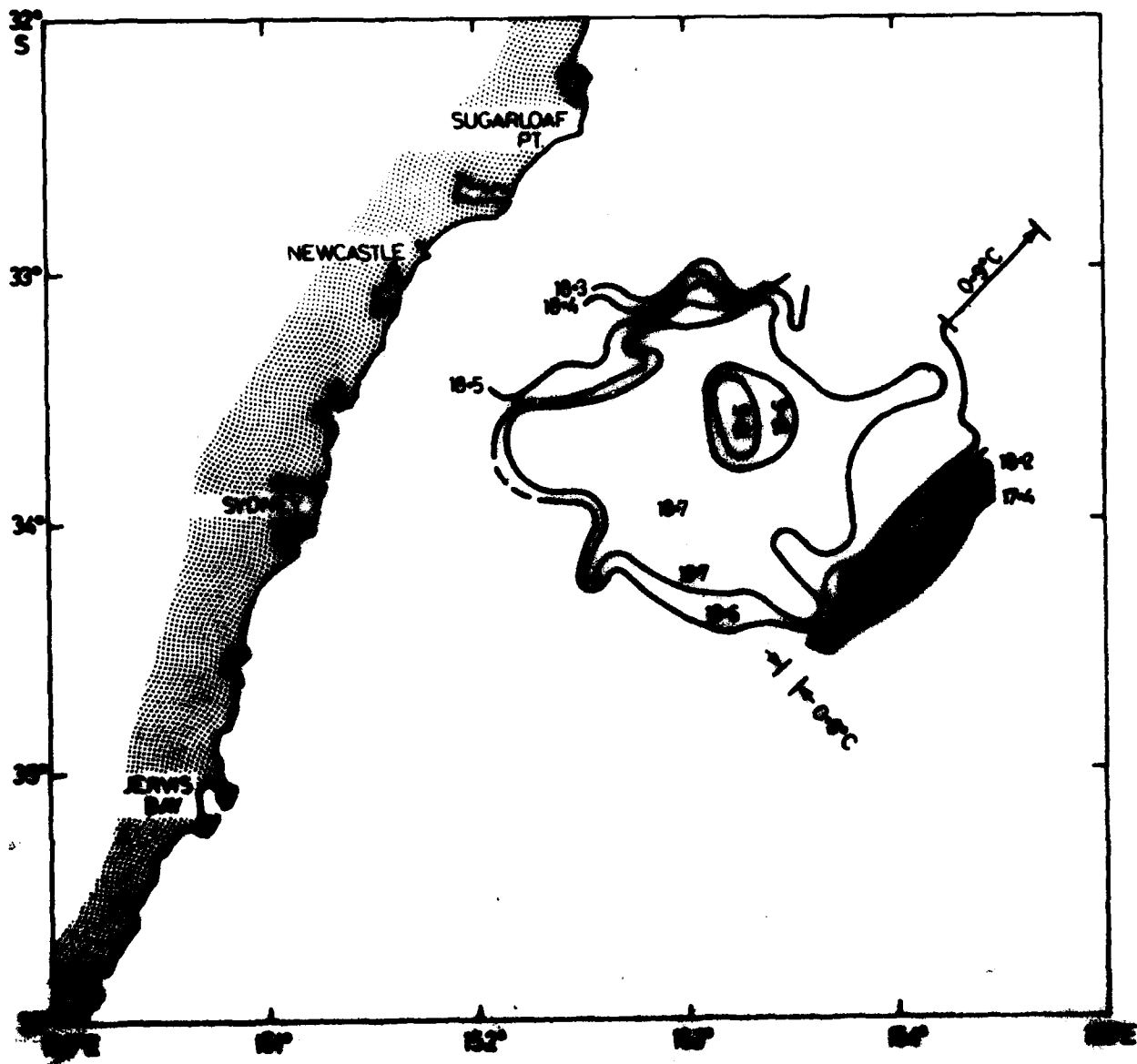


Fig. 15. SST (°C). Cruise SP 12/79. 20 Sept. - 3 Oct. 1979.

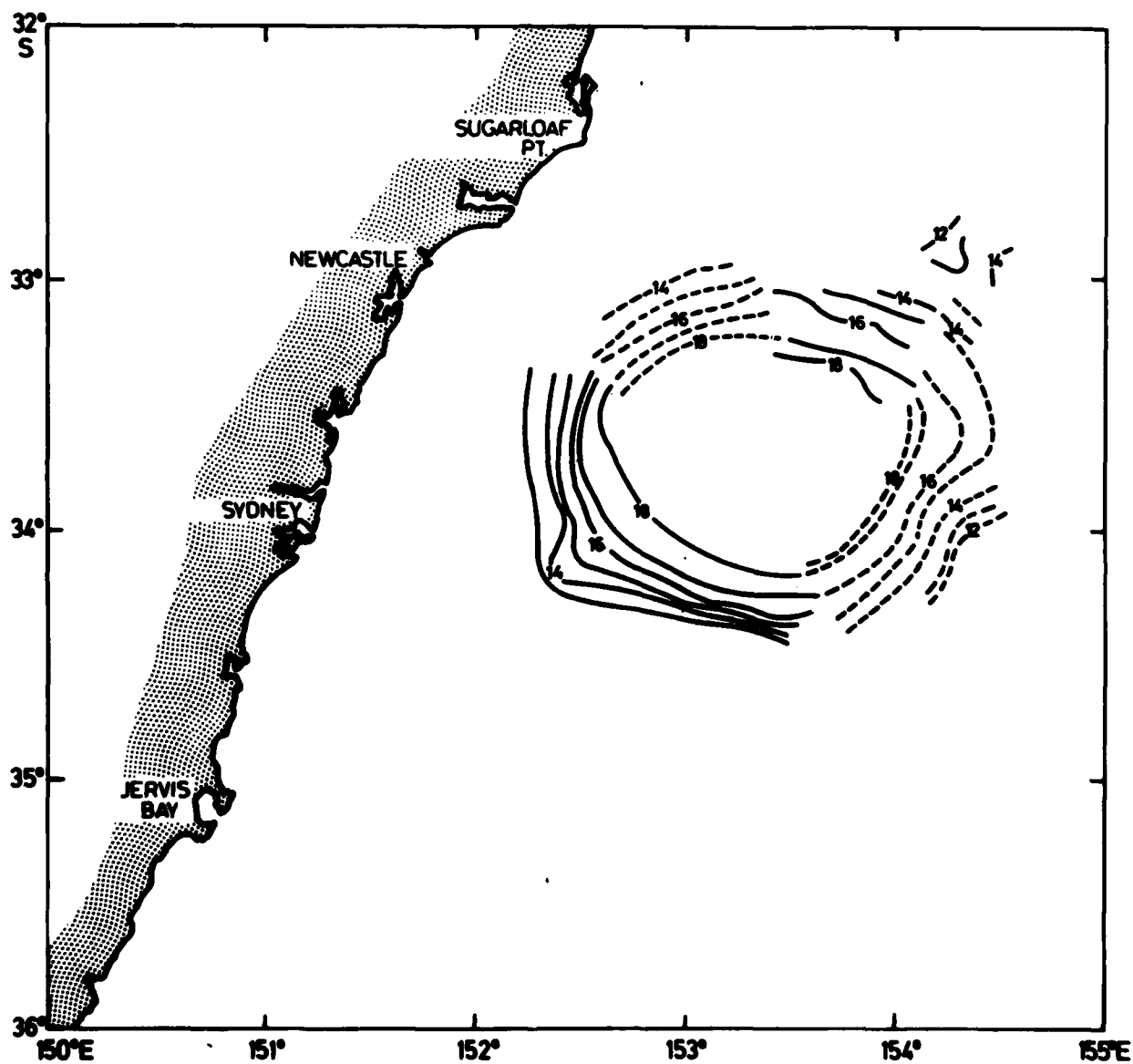


Fig.86. T_{250} (°C). Cruise SP 10/79.

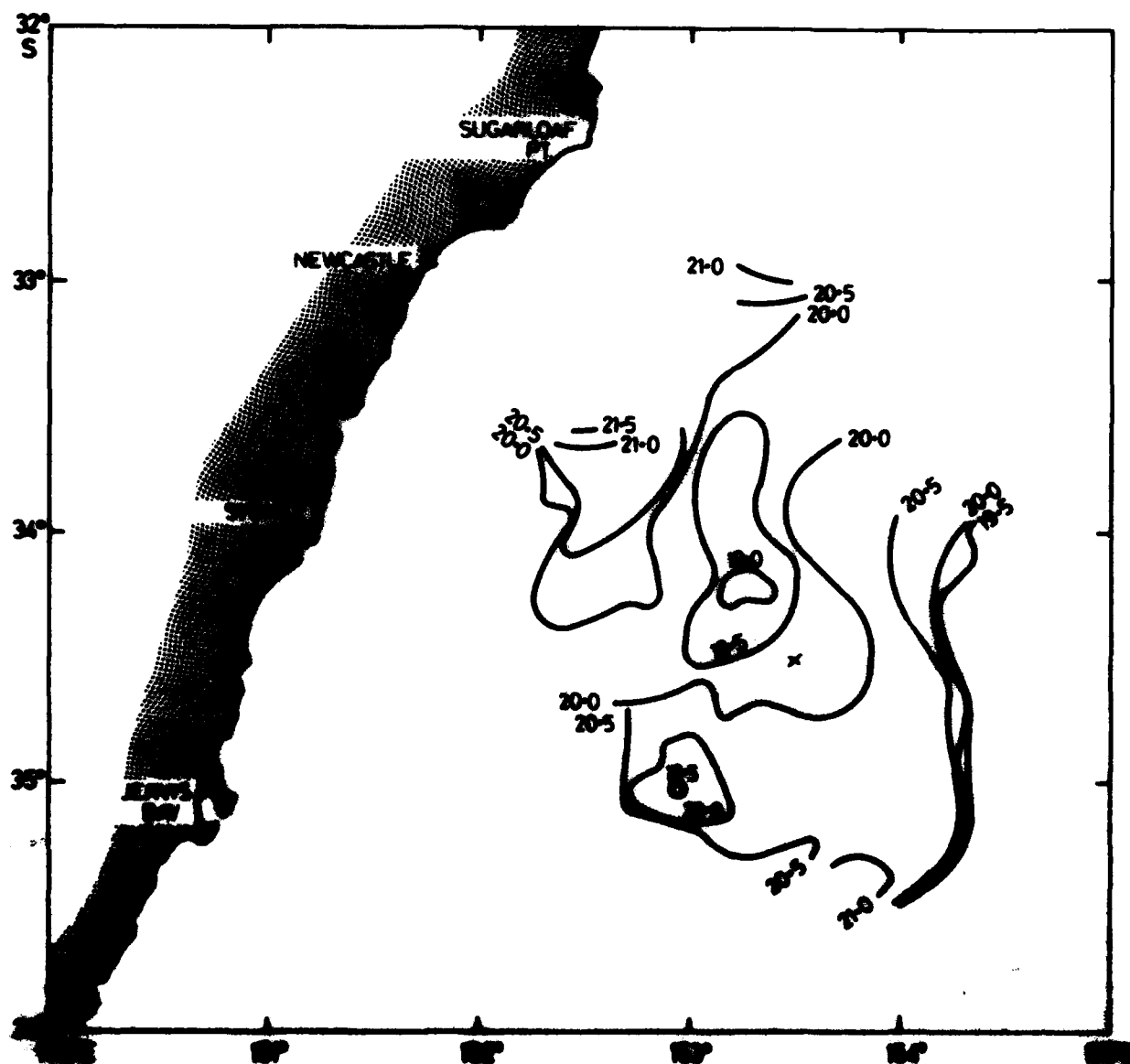


Fig. 87 SST (C). Cruise SP 11/79. 17-30 Oct. 1979.

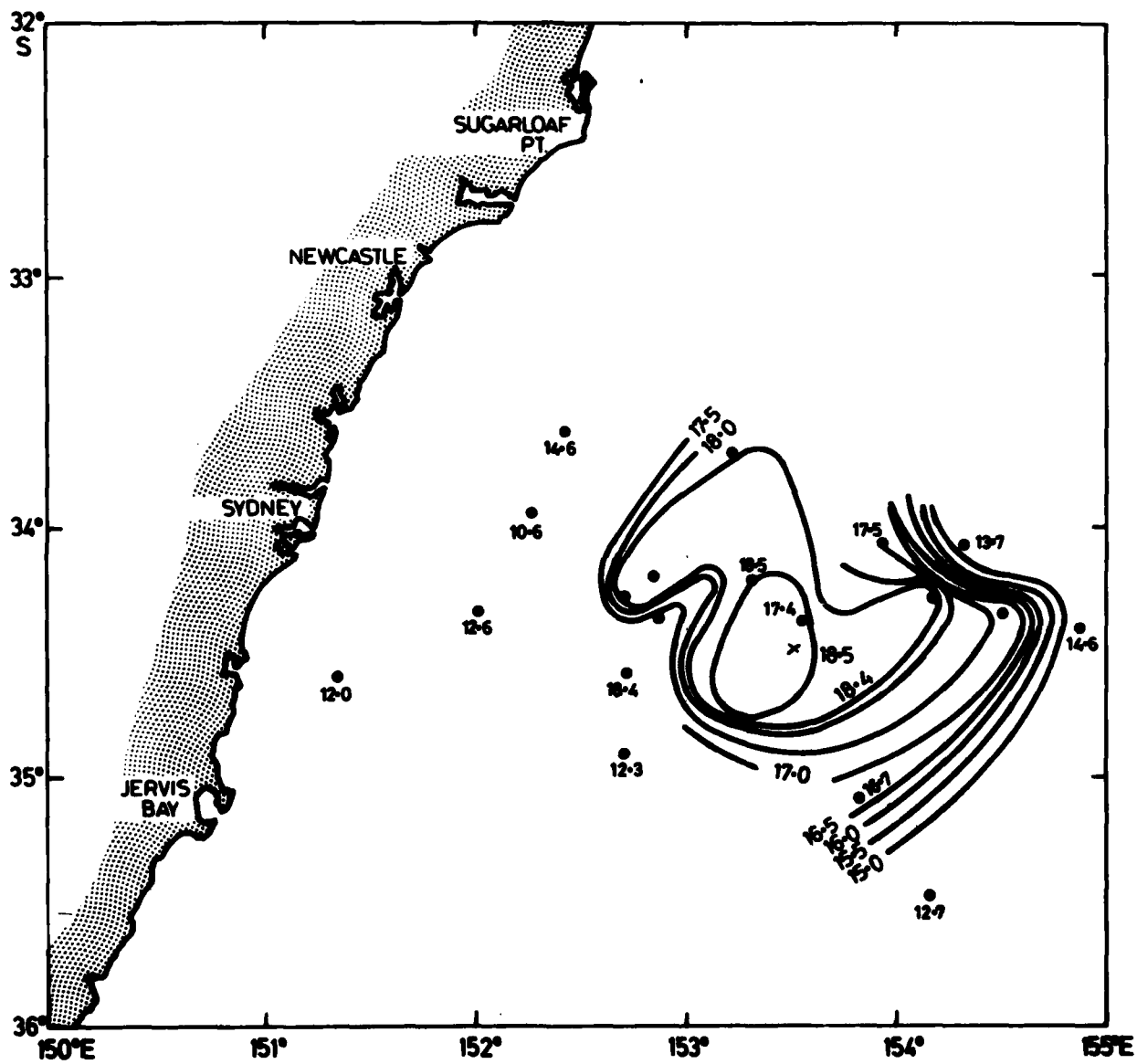


Fig. 88. T₂₅₀ (°C). Cruise SP 11/79.

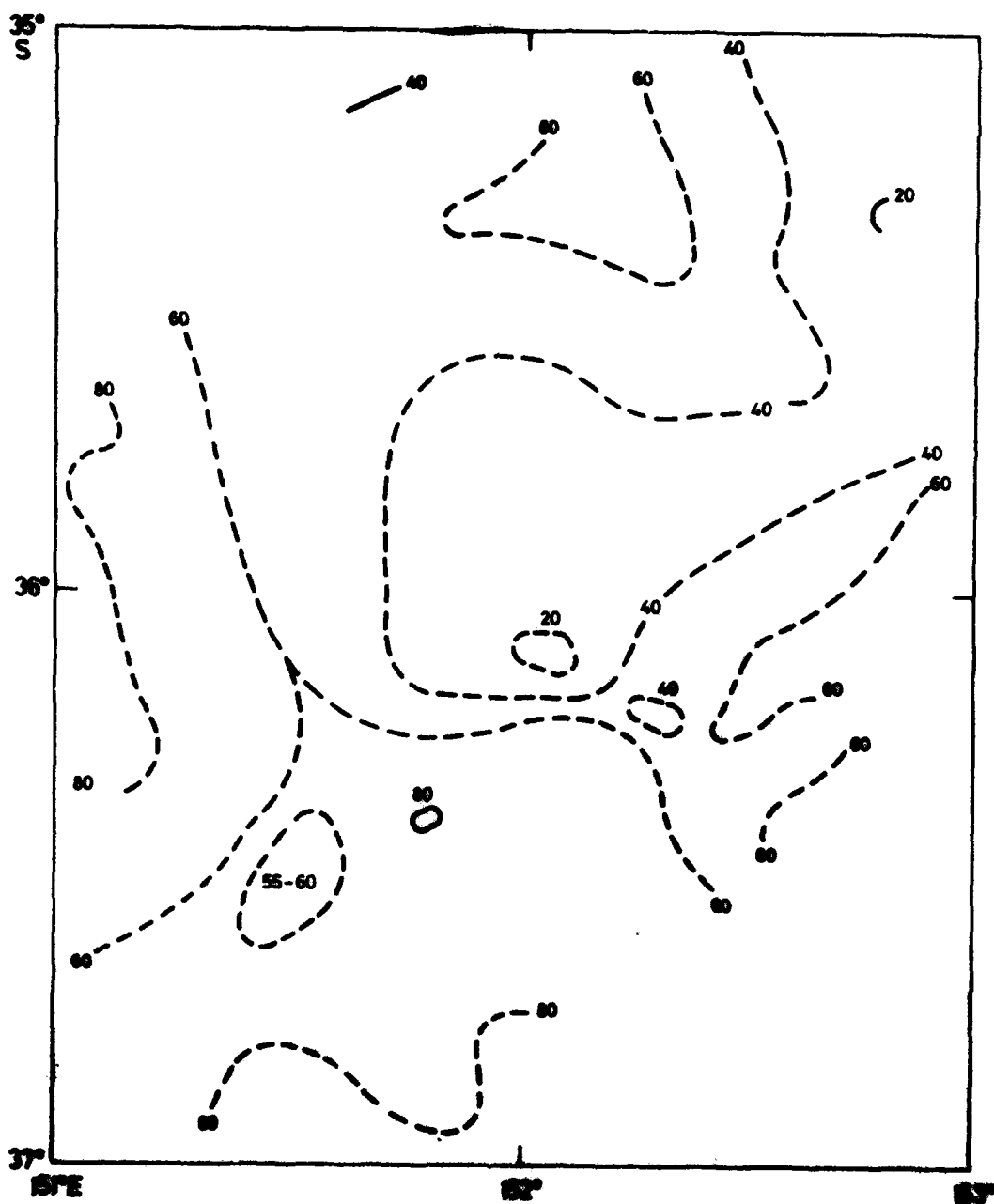


Fig. 80. MLD. Cruise SP3/80. 5-12 Feb. 1980.

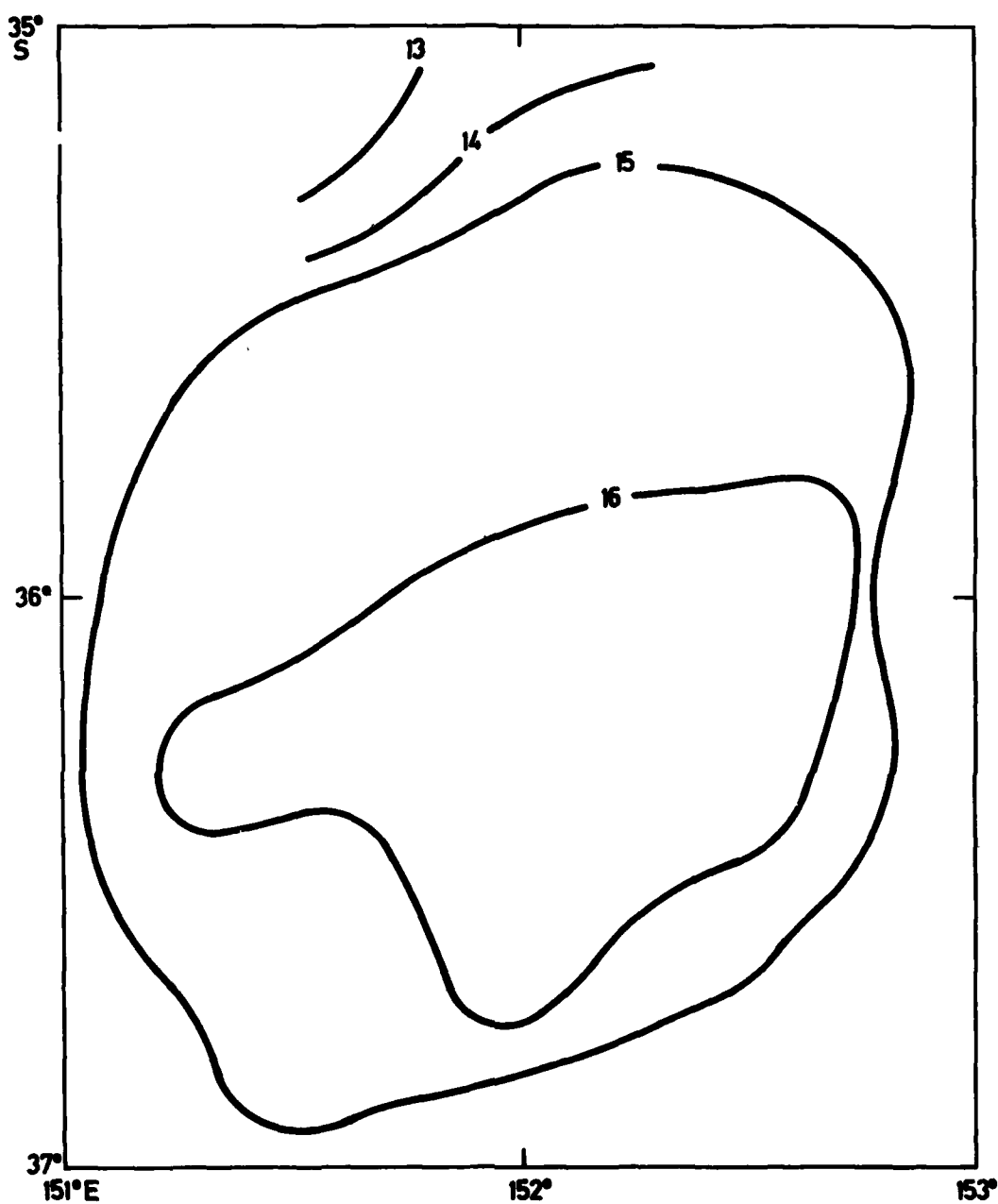
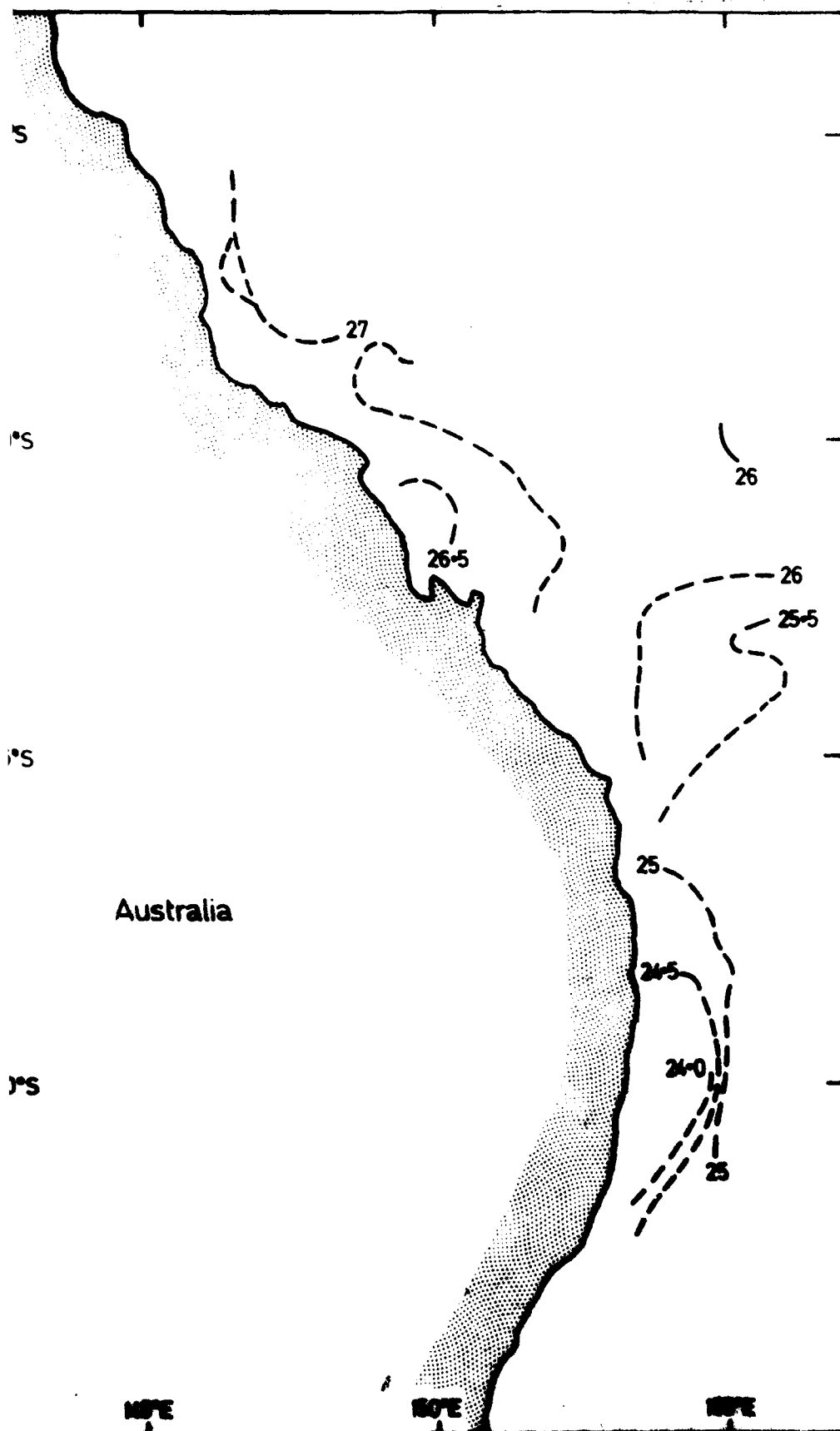
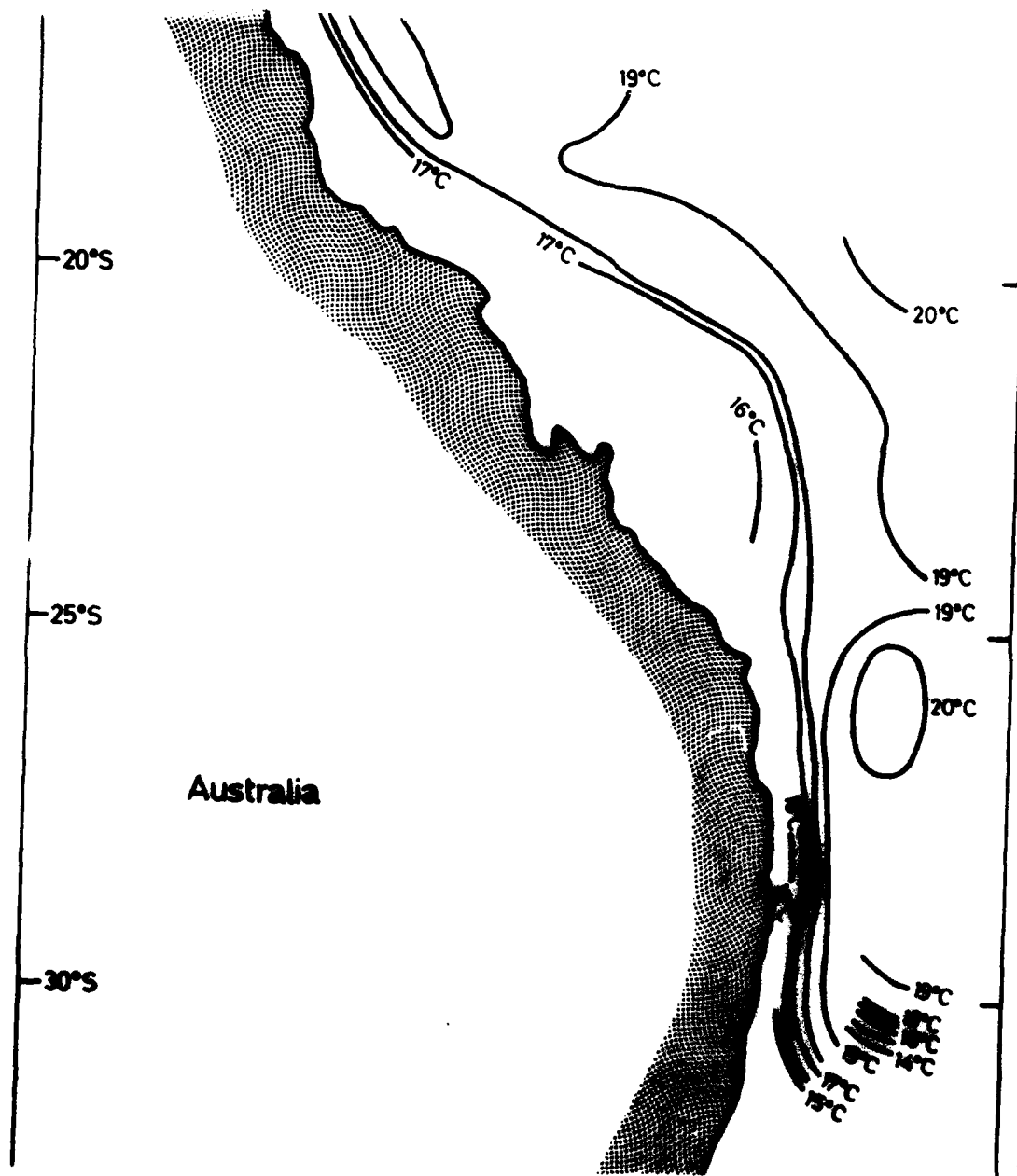


Fig.91. T250(°C). Cruise Sp 3/80. 5-12 Feb.1980.



02. 207 (C). Cruise SP 6/80. 11-30 April 1980.



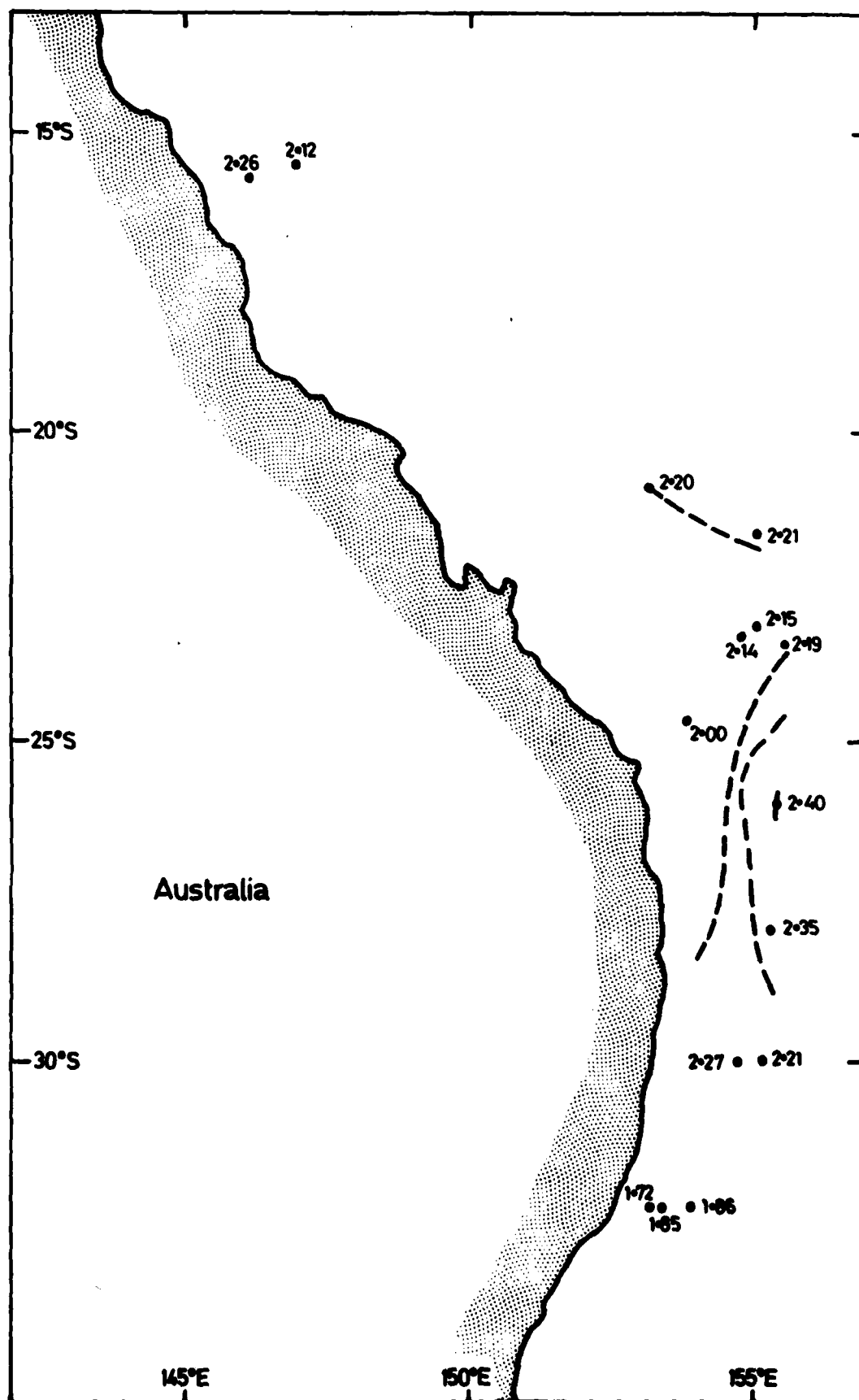


Fig.94. Dynamic Height relative to 1300m. Cruise SP 6/80.

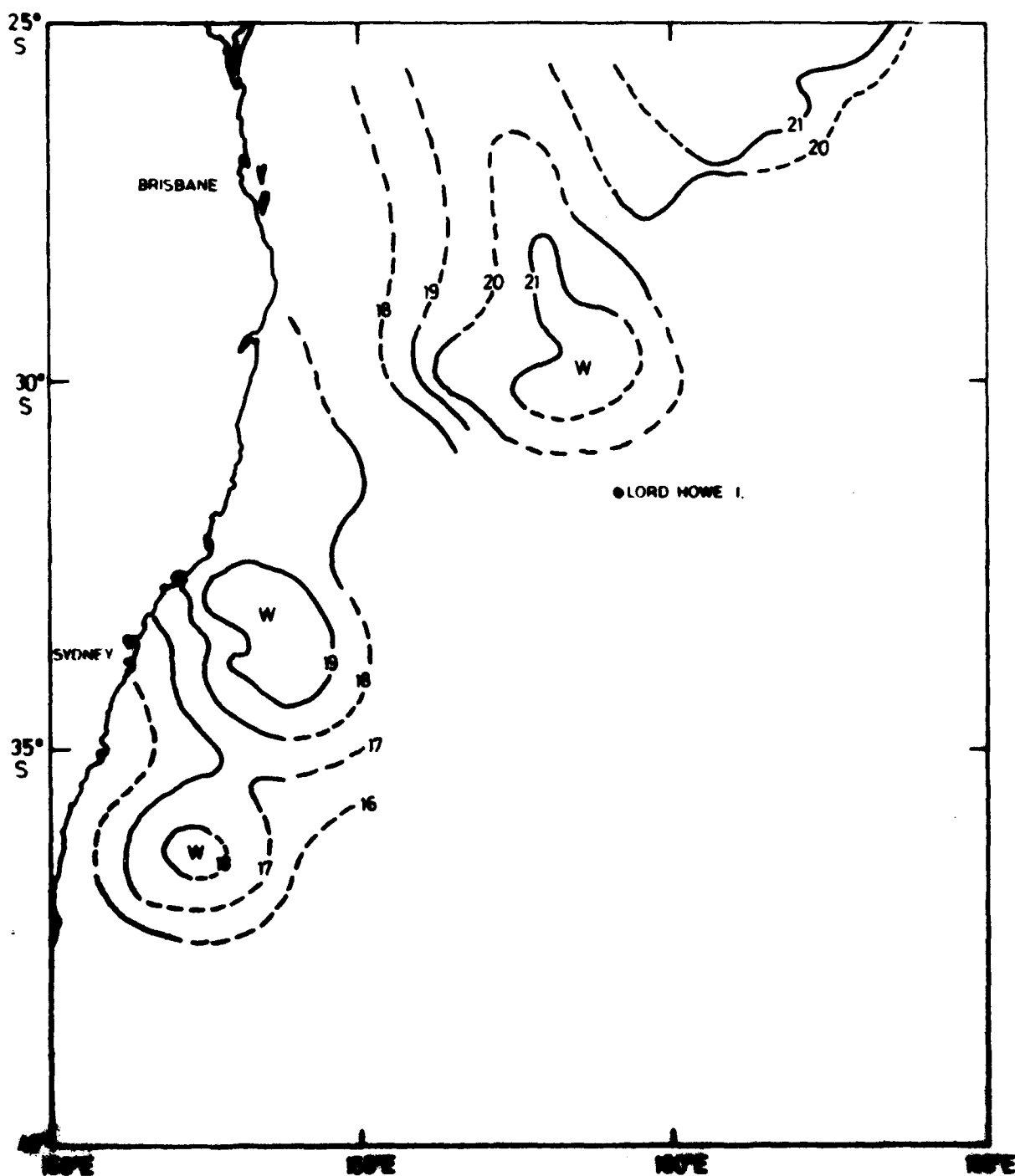


Fig. 85. SST. Sprightly 3/80. 30-31 July. HMAS Yarra. 25-27 July.

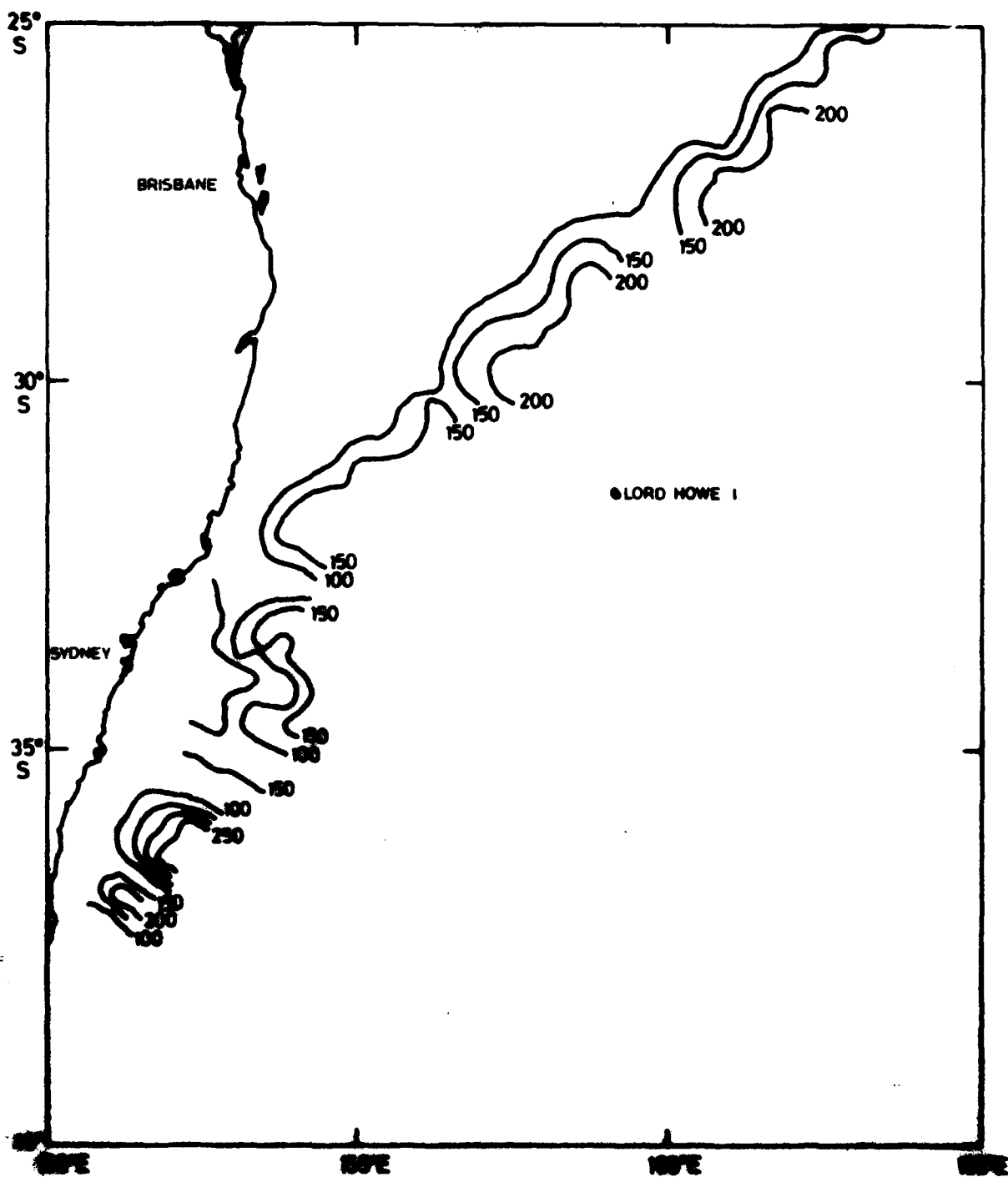


Fig. 96. M.L.D. Sprightly 3/80. 30-31 July. HMAS Yarra. 25-27 July.

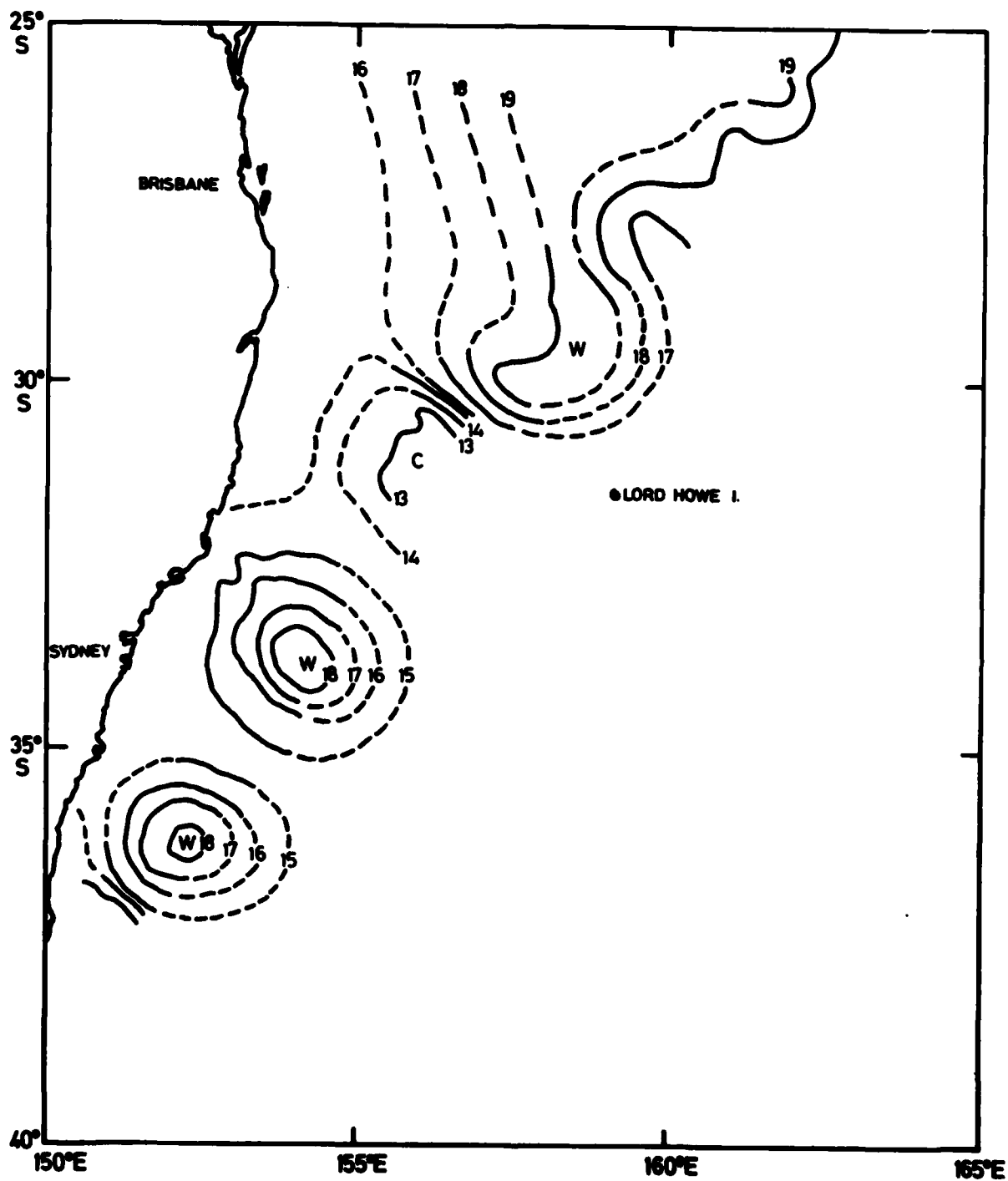


Fig.97. T250. Sprightly 3/80. 30-31 July. HMAS Yarra. 25-27 July.

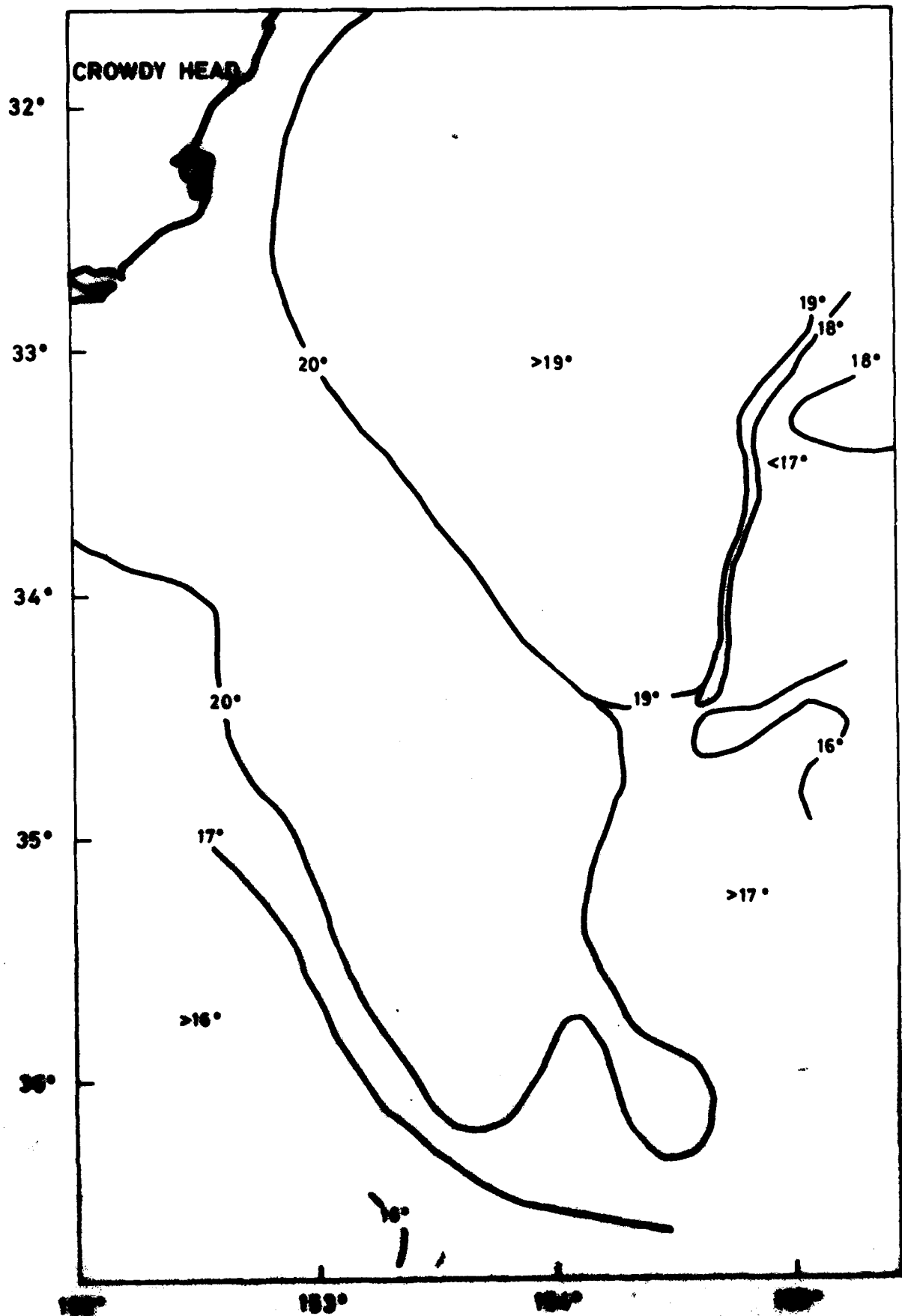


Fig. 20. SST 204/88 152°E - 155°E

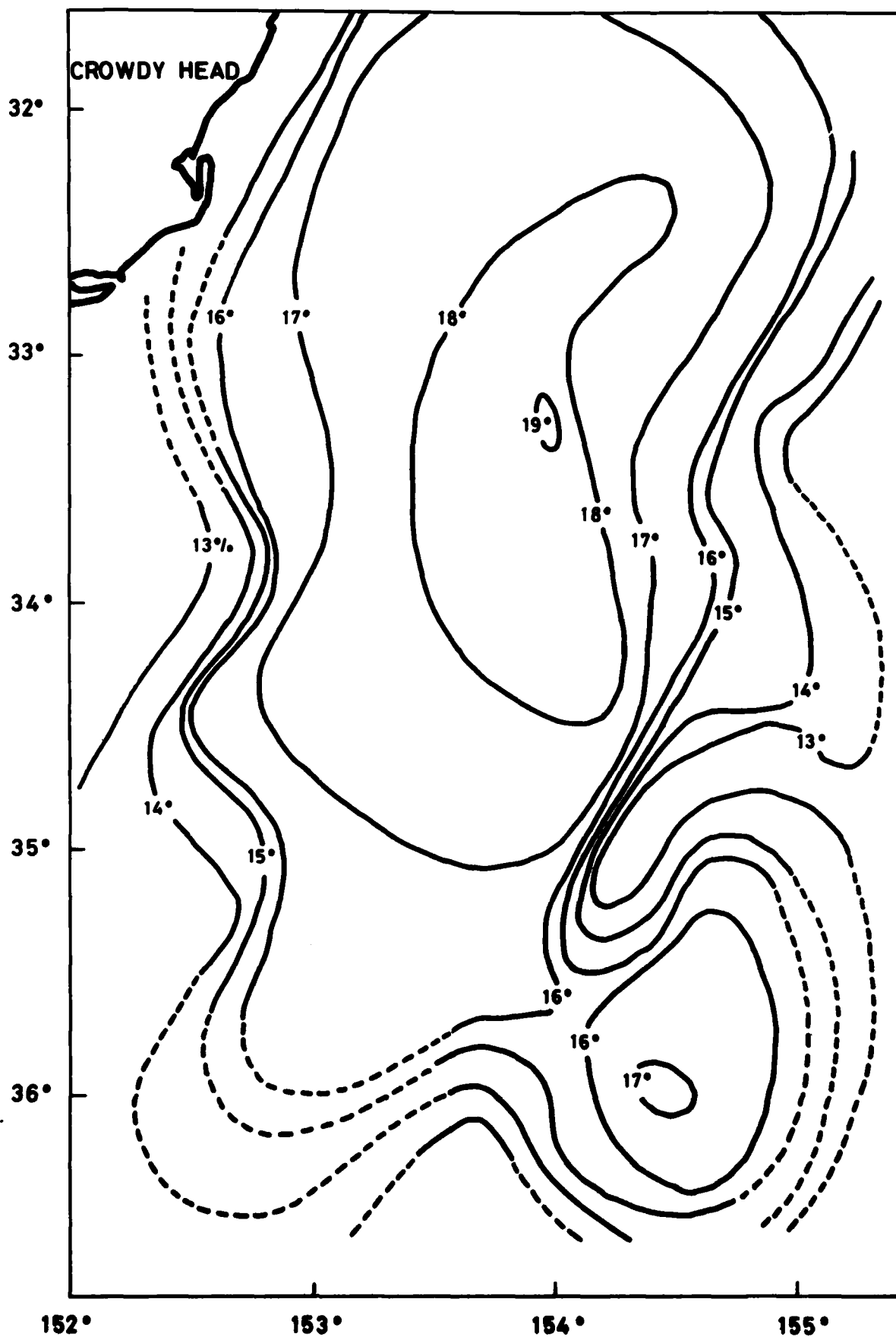


Fig. 99. T250 S04/81 SEP25 - OCT18 1981.

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16. Abstract Comparisons are presented between patterns of sea-surface temperature, temperature at 250m, mixed-layer depth and dynamic height for the western Tasman Sea. Data are from ship cruises and aerial surveys. It is shown by comparing deep current structures, shown by the temperature fields at 250 metres and/or dynamic heights, with surface temperature patterns that on many occasions the latter revealed the East Australian Current flowing down the coastline, turning eastwards between 30° and 32° S and, sometimes, turning back to the north. Also on most occasions in winter and spring, and sometimes in summer-autumn, warm-core eddies were apparent in surface temperature patterns. In general, surface mixed-layers are deeper above anticyclonic features and shallower above cyclonic features.			

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